THE PROBLEM AND PRACTICE OF ARITHMETIC

THIRD BOOK

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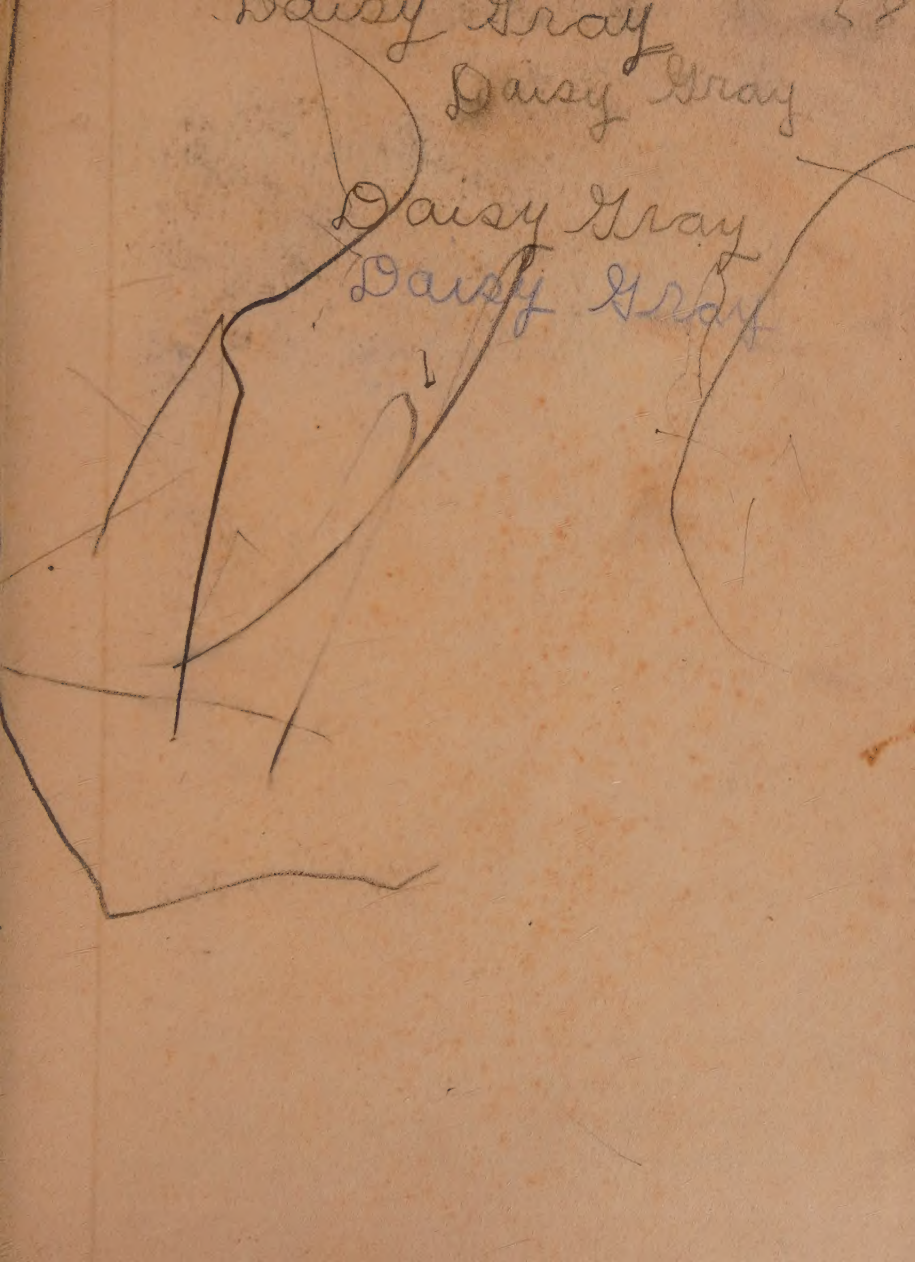
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The Problem and Practice Arithmetics

THIRD BOOK

BY

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PREFACE

IN THE preparation of this book of "The Problem and Practice Arithmetics," the authors have recognized the significant changes that have taken place both in the spirit of teaching and in the content and objectives of modern courses designed for the last years of the elementary school.

In the first place, it should be observed that the pupil's previous work in arithmetic has, of necessity, been chiefly concerned with acquiring the requisite skills in the fundamental operations and processes. From now on, unless square root is studied, there is no new process to be learned. From the arithmetic point of view, therefore, the work must consist chiefly of topics that have already been covered. With computation as the sole end in view, the old-fashioned arithmetic retaught these processes in the same dry formal manner as before, and failed utterly to recognize the important function of the modern school in training boys and girls for future citizenship.

The arithmetic course for the upper grades can, if properly developed, be of great social value. There is an immense amount of information that arithmetic can give about our American daily life, our vast resources, our modern business organizations, our great industries, and our state and national governments. With all of these the educated citizen must be familiar if he is to take his place as an intelligent member of a community. A glance at the Contents of this book will reveal the range of topics that can be covered in an arithmetic that is organized from the social point of view to meet the

awakening interests of pupils in the life of the world with which they are rapidly becoming familiar through their studies in geography, history, civics, and science.

At the same time, attention has been paid to the development of the work from the arithmetic point of view. Skills once acquired are rapidly lost if not used, and distributed practice upon basic facts and processes is therefore provided at intervals throughout the book. In this work, emphasis is placed upon the types of computation that people actually need to use. There is also provided sufficient review of the important processes, such as the different cases of percentage and the technique of problem solving, together with practice in estimating and checking answers.

Great care has also been taken in typography and in illustration. The clear type, the open, well-arranged pages, the absence of explanations in small type, the boxing of illustrative examples, and the clear distinction between text and exercise material all contribute to progress in learning. With the material carefully organized by means of the unit page, both teacher and pupil will find the text easy to use.

These are a few of the distinguishing features of this book. It is the hope of the authors that it will thus meet the need for a textbook in arithmetic embodying the latest and most sanely progressive ideas in the teaching of the subject.

David Eugene Smith

Eva May Luse

Edward Longworth Morse

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The Reward of Labor

CHAPTER ONE

EARNING, SPENDING, AND SAVING MONEY

I. EARNING MONEY

How Boys and Girls can Earn

IN ORDER to have food, clothes, and a place in which to live, or to be able to buy automobiles, radios, theater tickets, and the like, **someone has to earn the money to pay for them.** When you leave school most of you will have to earn money, — some of you perhaps are doing so now.

Here are some problems about how boys and girls can earn.

1. At 30¢ an hour, how much did Joe earn by working 4 hr. in a grocery store last Saturday morning?

2. Mollie earned $1.50 by taking care of Mrs. Rice's baby 6 hr. last week. How much was she paid per hour?

3. Fred was paid $3\frac{1}{2}$¢ a box for picking strawberries. How much did he earn by picking 64 boxes?

4. Mr. Cole paid Dick 75¢ for washing the car, 55¢ for mowing the lawn, and 30¢ an hour for $2\frac{1}{2}$ hr. of work in the garden. How much did Dick earn in all?

5. Mrs. Cole pays Isabel 35¢ an hour for helping with the housework. Last week she worked 2 hr., $1\frac{1}{2}$ hr., $3\frac{1}{4}$ hr., $2\frac{1}{2}$ hr., $3\frac{3}{4}$ hr., and 2 hr. How much did she earn that week?

Practice in Addition

HERE are several different kinds of additions. Practice on them until you can do them quickly and accurately. Whenever you can write the answers on a piece of folded paper placed under the rows, **do not copy the examples.**

Add, and then check by adding in the opposite direction:

1.	2.	3.	4.	5.
476	1088	$21.52	$19.53	889.2
8782	957	13.85	76.16	957.3
9979	6685	24.69	70.04	1.3
6084	3956	34.56	2.41	80.3
9893	7078	42.01	26.40	791.0
1710	6879	90.78	34.57	868.9

Copy and add:

6. 2568, 4008, 9691, 7889, 654, 6727, 79, 6956

7. 3708.0, 8546.4, 612.7, 2016.0, 1525.3, 746.8

Find the sums:

8.	9.	10.
1 ft. 6 in.	5 bu. 3 pk.	1 hr. 25 min. 30 sec.
2 ft. 10 in.	2 bu. 0 pk.	5 hr. 40 min. 55 sec.
9 in.	1 bu. 2 pk.	35 min. 49 sec.

Copy, add, and then check:

11. $6.50, $2.15, $1.06, $0.85, $1.25, $10, and $3.10

12. 1 dollar, 3 half dollars, and 9 quarters

13. 10 dollars, 7 quarters, and 8 nickels

14. 1 sq. yd. 8 sq. ft. and 3 sq. yd. 1 sq. ft.

15. 1 lb. 8 oz., 3 lb. 4 oz., 2 lb. 12 oz., and 4 lb. 8 oz.

Practice in Subtraction

THIS page of examples will help you to find any hard spots in subtraction. **Always check your work in subtraction by adding the answer to the number subtracted, adding upward.**

Subtract, and then check your work:

1. 7103	2. 5230	3. $60.09	4. $80.03	5. $91.17
4675	3757	35.69	66.87	74.57
6. 717.7	7. 92.43	8. 8221	9. 3.112	10. 9.422
544.5	69.46	3238	1.989	8.840
11. 5432	12. 6332	13. 711.0	14. 7554	15. 975.4
4079	5368	412.3	6789	595.6
16. 7543	17. 5665	18. 9888	19. 61.76	20. 8.299
4939	4678	3989	35.78	2.234

From $10.00 subtract, in turn,

21. $7.62	23. $1.73	25. $6.15	27. $9.16	29. 87¢
22. $3.09	24. $0.38	26. $0.54	28. $2.09	30. $4.81

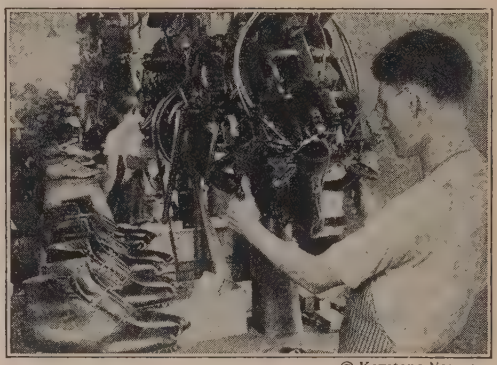
Subtract:

31. 2 lb. 9 oz. from 3 lb.
32. 500 lb. from $2\frac{1}{2}$ T.
33. 1 gal. 1 pt. from 3 gal.
34. 24 in. from 1 yd. 6 in.

Find the difference in time between these dates:

35. June 21, 1929 and Aug. 25, 1935
36. Oct. 10, 1932 and March 12, 1938

1. Some workmen are paid by the hour, some by the day, and some by the week. Mr. Burns, who works in a shoe factory that runs 44 hr. a week, is paid 85¢ an hour. How much are his wages for a full week's work?



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2. Mr. Westlake works in the shipping room of the factory in Ex. 1, and earns $4.50 a day. He works $5\frac{1}{2}$ da. a week. How much are his wages for a week's work?

3. Harold Marsh, who works in the office of the shoe factory in Ex. 1, earns $27.50 a week. Taking $5\frac{1}{2}$ da. to the week, find how much he earns per day.

4. Mr. Long, a bricklayer, earns $1.50 an hour. How much does he earn in a week in which he works $5\frac{1}{2}$ da., 8 hr. a day?

5. Carpenters in the town where Mr. Wood lives earn $\$1.37\frac{1}{2}$ an hour and work 8 hr. a day. How much does a carpenter earn on a job that takes $3\frac{1}{2}$ da. at 8 hr. a day?

6. Tom Gore never learned a trade. He makes his living by odd jobs. Last week he had 36 hr. of work. At 55¢ an hour, how much did he earn that week?

7. Mr. Pond pays the plumbers in his shop $1.60 an hour, with "time and a half" for overtime; that is, for time worked in excess of the regular 8 hr. a day. Last week one of the men worked 44 hr. regular time and $5\frac{1}{2}$ hr. overtime. How much extra did he earn? How much did he earn in all?

Practice in Multiplication

HERE are some examples that show various kinds of multiplications. See if you can do them all both quickly and accurately, **checking your work by going over it a second time.**

The following multiplications are sometimes troublesome. See if you can give all the products orally:

1.	5	4	0	6	9	4	8	7	4	3
	5	8	9	4	3	7	3	0	6	9
2.	7	8	7	9	8	8	9	7	5	9
	6	8	7	5	9	5	6	8	9	7
3.	7	8	6	8	5	9	6	9	6	6
	9	6	9	7	8	8	7	9	8	6
4.	3	5	7	4	5	8	5	9	6	7
	5	6	5	9	0	4	7	4	5	4

Multiply, and then check your work:

5. 2476	6. 3508	7. $80.53	8. $53.80
569	695	487	213
9. 2469	10. 9640	11. $46.97	12. $72.10
470	503	812	721
13. 7129	14. 8791	15. $79.08	16. $45.06
389	456	689	798
17. 8485	18. 6290	19. $68.75	20. $88.27
407	395	509	658

1. Last week 36 girls in Mr. Parr's candy factory earned an average of \$14.24 apiece. How much did all the girls earn that week?

2. One of the girls in the factory in Ex. 1 has to travel by the railroad 14.24 mi. each day in getting to and from her work. How far does she travel in 36 da.?

3. At 1.6¢ per box, how much will a girl earn for packing 45 boxes of candy?

4. A workman in England was paid £ 4 (4 pounds) per week. The English money unit called the **pound** is worth \$4.87. How much in our money did he earn per week?

Tell why the decimal point is placed as it is in each of these examples:

5. $0.25 \times 0.09 = 0.0225$
6. $0.06 \times 0.05 = 0.0030$
7. $2.5 \times 0.3 = 0.75$
8. $0.8 \times 0.07 = 0.056$

Find the products:

9. 0.3×0.75
10. 0.05×0.87
11. 0.08×0.05
12. 1.5×0.6
13. 0.24×0.2
14. 1.6×0.5
15. 0.04×0.04
16. 0.08×12
17. 0.06×0.09

Multiply, being careful about the decimal points:

18. 36.05 × 79	19. 6184 × 0.85	20. 94.78 × 0.097	21. 39,000 × 0.0056
22. 0.0907 × 6.8	23. 91.67 × 3.04	24. 5.463 × 0.26	25. 90.87 × 890

1. Larry delivers papers early each morning at 62 houses. He makes 1¢ on each weekday paper and $2\frac{1}{2}$¢ on each Sunday paper. How much does he make each week?

2. Taking 52 wk. to the year, find from Ex. 1 how much Larry would make in a year if there were no changes in the number of customers.

3. Larry also delivers a weekly magazine. He makes $1\frac{1}{2}$¢ on each copy that he delivers. Last week he delivered 48 magazines. How much did he make?

4. At an average of 42 magazines a week, find how much Larry would make from his magazines in a year of 52 wk.

5. Larry's brother Fred made an average of $2.80 a week from weekday papers, and $1.10 from Sunday papers. How much did he make in 52 wk.? How much more or less was this than the amount that Larry made in Ex. 2?

6. Larry and Fred have a chance to buy the paper stand at the railroad station. It will cost them $120. Larry has saved $46.80 and Fred has saved $58.72. How much more do they need in order to buy the stand?

7. At the paper stand they make an average of $14.56 a week from the sale of magazines. To how much will this amount in a year of 52 wk.?

Practice in Division

CAN you divide both quickly and accurately? Practice on the examples on this page. **Remember to check your work by multiplying the quotient by the divisor, adding the remainder when there is one.** The result should equal the dividend.

The following divisions are sometimes troublesome. See how quickly you can give the quotients orally:

1. 6)42	8)64	6)48	8)40	5)40	7)56
2. 9)63	7)42	7)49	9)54	9)81	6)54
3. 5)45	8)56	8)48	9)72	6)36	4)28
4. 7)63	8)72	5)15	6)30	9)45	5)35
5. 9)36	3)15	4)32	4)36	5)30	7)28

Divide, writing any remainder in the division as a fraction in the quotient:

6. 50)7350	13. 32)6728	20. 35)1540	27. 125)15,625
7. 75)7125	14. 40)1765	21. 25)4030	28. 22)$171.60
8. 84)7056	15. 77)7711	22. 19)1216	29. 31)$55.18
9. 98)7154	16. 33)9966	23. 64)1160	30. 46)$142.14
10. 67)1608	17. 46)9568	24. 87)6916	31. 92)$283.36
11. 56)3808	18. 85)5440	25. 94)3384	32. 67)$653.25
12. 49)2401	19. 66)5874	26. 48)9888	33. 46)$417.68

34. How much larger is $80.24 ÷ 17 than $48.64 ÷ 16?

35. How much less is $240 ÷ 125 than $251.72 ÷ 124?

IN THE work of the previous pages you have several times used easy fractions like $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{3}{4}$, and have used easy decimals. Before going further, you should **be sure that you know the meaning of fractions, decimals, and per cents.**

1. In "$\frac{3}{4}$ of a melon," what is the name of the parts into which the melon is divided? How many such parts are there?

2. In the fraction $\frac{3}{4}$, which is the **numerator**? Which is the **denominator**? What are the terms of the fraction?

3. What is the simplest form in which $\frac{8}{12}$ can be expressed? Express in lowest terms: $\frac{4}{6}$, $\frac{9}{12}$, $\frac{12}{16}$, $\frac{18}{32}$, $\frac{5}{25}$, $\frac{12}{48}$, $\frac{24}{32}$.

4. The fractions $\frac{1}{4}$ and $\frac{3}{4}$ have the **common denominator** 4. Express $\frac{3}{4}$ and $\frac{5}{8}$ with the common denominator 8; with the common denominator 16; with the common denominator 24.

5. What is the **least common denominator (L. C. D.)** of the fractions $\frac{1}{2}$ and $\frac{5}{6}$? of $\frac{3}{4}$ and $\frac{7}{8}$? of $\frac{2}{3}$ and $\frac{5}{12}$? of $\frac{1}{6}$ and $\frac{5}{16}$?

6. Reduce $\frac{75}{100}$ to lowest terms. In what other way can you write $\frac{75}{100}$ as hundredths?

7. **50% means 50 hundredths, or 0.50.** Read these per cents as hundredths: 20%, 75%, 6%, 17%, $12\frac{1}{2}$%, $66\frac{2}{3}$%.

8. Read the following decimals as per cents: 0.40, $0.33\frac{1}{3}$, 0.01, $0.37\frac{1}{2}$, $0.00\frac{1}{2}$, 1.25, $3.66\frac{2}{3}$.

9. See if you remember all these per cents and fractions:

$25\% = \frac{1}{4}$	$10\% = \frac{1}{10}$	$66\frac{2}{3}\% = \frac{2}{3}$	$37\frac{1}{2}\% = \frac{3}{8}$
$50\% = \frac{1}{2}$	$5\% = \frac{1}{20}$	$16\frac{2}{3}\% = \frac{1}{6}$	$62\frac{1}{2}\% = \frac{5}{8}$
$75\% = \frac{3}{4}$	$33\frac{1}{3}\% = \frac{1}{3}$	$12\frac{1}{2}\% = \frac{1}{8}$	$87\frac{1}{2}\% = \frac{7}{8}$

HERE are four examples that show how to add, subtract, multiply, and divide with fractions of the kind that people use. Study them and then answer the questions below.

Write	Think	Write
(1) $3\frac{7}{8}$	$\frac{4}{8}+\frac{7}{8}=\frac{11}{8}$	(3) $2\frac{1}{2}\times 3\frac{1}{2}=\frac{5}{2}\times\frac{7}{2}$
$+2\frac{1}{2}$	$\frac{11}{8}=1\frac{3}{8}$	$=\frac{35}{4}$
$6\frac{3}{8}$	$1+2+3=6$	$=8\frac{3}{4}$
(2) $6\frac{1}{4}$	$6\frac{1}{4}=6\frac{2}{8}=5\frac{10}{8}$	(4) $\frac{7}{8}\div\frac{3}{4}=\frac{7}{\cancel{8}_{2}}\times\frac{\cancel{4}^{1}}{3}$
$-2\frac{5}{8}$	$\frac{10}{8}-\frac{5}{8}=\frac{5}{8}$	
$3\frac{5}{8}$	$5-2=3$	$=\frac{7}{6}=1\frac{1}{6}$

1. In (1), what is the least common denominator of the two fractions? Why is the 1 added to the 2 and the 3?

2. In (2), what is the least common denominator of the two fractions? Why should you think of $6\frac{2}{8}$ as $5\frac{10}{8}$?

3. In (3), could you just as easily have multiplied without first reducing the $2\frac{1}{2}$ and $3\frac{1}{2}$ to improper fractions?

4. From (3), complete this statement: **To find the product of two fractions, multiply the numerators together and then multiply the ——.**

5. From (4), complete this statement: **To divide by a fraction, multiply by ——.**

6. In (4), by what were both numerator and denominator divided in canceling the 8 and the 4?

1. Mrs. West bought $3\frac{1}{2}$ lb. of beef and $4\frac{7}{8}$ lb. of lamb. How many pounds of meat did she buy?

2. Dick had $8\frac{1}{4}$ yd. of fishline, but lost $3\frac{5}{8}$ yd. when his hook caught on a snag. How much line was left?

3. The Reed family uses $2\frac{1}{2}$ qt. of milk a day, and the Jones family uses $1\frac{1}{2}$ times as much. How many quarts a day does the Jones family use?

4. How many pieces, each $2\frac{1}{2}$ ft. long, can a carpenter saw from a board that is $17\frac{1}{2}$ ft. long?

See if you can do these additions correctly:

5.	6.	7.	8.	9.
$\frac{1}{2}$	$\frac{3}{4}$	$\frac{7}{8}$	$2\frac{1}{2}$ ft.	$7\frac{3}{4}$ lb.
$\frac{7}{8}$	$\frac{5}{8}$	$\frac{5}{8}$	$4\frac{3}{4}$ ft.	$6\frac{1}{2}$ lb.

See if you can do these subtractions correctly:

10.	11.	12.	13.	14.
$\frac{7}{8}$	1	$2\frac{5}{8}$	$7\frac{1}{2}$ ft.	$33\frac{1}{3}$ yd.
$\frac{5}{8}$	$\frac{3}{4}$	$1\frac{1}{2}$	$3\frac{3}{4}$ ft.	$16\frac{2}{3}$ yd.

Multiply, remembering to cancel when you can:

15. $\frac{1}{2} \times \frac{1}{4}$	18. $3 \times \frac{3}{4}$	21. $2\frac{1}{2} \times 2\frac{1}{2}$
16. $\frac{1}{2} \times \frac{3}{4}$	19. $6 \times \frac{2}{3}$	22. $3\frac{3}{4} \times 2\frac{7}{8}$
17. $\frac{3}{4} \times \frac{5}{8}$	20. $\frac{3}{4} \times 24$	23. $3\frac{1}{3} \times \$15.30$

Divide, remembering to cancel when you can:

24. $\frac{1}{2} \div \frac{1}{4}$	27. $\frac{1}{8} \div \frac{3}{4}$	30. $\frac{2}{3} \div \frac{1}{3}$	33. $5 \div 2\frac{1}{2}$
25. $\frac{1}{4} \div \frac{1}{2}$	28. $\frac{3}{4} \div \frac{1}{8}$	31. $\frac{1}{3} \div \frac{2}{3}$	34. $3\frac{1}{3} \div \frac{1}{3}$
26. $\frac{1}{4} \div \frac{1}{4}$	29. $\frac{3}{4} \div \frac{3}{8}$	32. $\frac{2}{3} \div \frac{1}{6}$	35. $4\frac{1}{2} \div 2\frac{1}{4}$

SINCE $25\% = \frac{1}{4}$, it is easy to find 25% of a number by simply taking $\frac{1}{4}$ of it. Similar easy methods can be used for any per cent which has a simple fractional equivalent, such as 50%, 75%, $33\frac{1}{3}\%$, $66\frac{2}{3}\%$, $12\frac{1}{2}\%$, and the like.

Since **per cent means hundredths,** finding any per cent of a number is the same as finding hundredths of the number.

For example, to find 6% of \$250, you have to find $\frac{6}{100}$, or 0.06, of \$250. The answer, as here shown, is \$15.00, or simply \$15.

\$250
0.06
\$15.00

To find a per cent of a number, write the per cent as a decimal and multiply the number by it.

1. Mr. Cole earns \$200 a month. He pays 20% of this for rent. How much rent does he pay per month?

2. Dick Holmes is earning \$24 a week. If he saves $12\frac{1}{2}\%$ of his weekly wages, how much does he save per week?

3. How much is 10% of \$1500? If a man earning \$1500 a year has his salary increased 10%, how much does he then earn?

4. Mr. Perry is a traveling salesman. His earnings depend upon how much he sells to the stores that he visits. Last year his earnings were \$4850, but this year they were 5% less. How much did he earn this year?

Find the following per cents:

5. 4% of \$250
6. 2% of \$500
7. 8% of \$850
8. 6% of \$1250
9. 20% of \$280
10. 40% of \$325
11. 51% of \$1200
12. 78% of \$1600
13. $12\frac{1}{2}\%$ of \$728
14. $16\frac{2}{3}\%$ of \$138
15. $37\frac{1}{2}\%$ of \$1304
16. $66\frac{2}{3}\%$ of \$6486

MANY salesmen earn their money by **selling on commission**; that is, they are not paid a regular salary but are paid a certain per cent upon the amount of each sale. Men who sell clothing, stoves, land, houses, insurance, automobiles, and many other things are generally paid in this way.

For example, a salesman who is paid a commission of 4% on a sale amounting to \$1250 earns $0.04 \times \$1250$, or \$50.

Amount of commission = per cent × amount of sale.

1. Mr. Green is an automobile salesman. If he receives a commission of 5% for selling a car for \$1200, to how much does his commission amount?

2. Tom Green sold pop corn at the picnic grounds on the Fourth of July. He sold 580 bags at 10¢ each, and was paid a commission of 20% by the man who owned the pop-corn stand. How much did Tom earn in all?

3. Tom's uncle sold Mrs. Black's house for \$12,500. At $3\frac{1}{2}$%, how much commission did he earn on the sale?

4. During the summer vacation at college, Dick Green took orders for an encyclopedia which sold for \$48 a set. He was paid a commission of 20%. How much did he earn the day that he took orders for 5 sets?

5. A salesman for a wholesale radio company receives a commission of $16\frac{2}{3}$%. Last year he sold \$24,900 worth of radio sets and supplies. How much commission did he earn?

6. Mildred Gray is a clerk in a department store. She is paid a salary of \$15 a week and a commission of 2% on her sales. Last week she sold \$840 worth of goods. How much in all did she earn that week?

Problems about Commission

1. A wholesale grocery salesman sold 640 lb. of coffee at $37\frac{1}{2}¢$ a pound. What was the amount of the order? At 8%, what was the amount of the salesman's commission?

2. In Ex. 1, how much commission would the salesman receive for selling 4800 lb. of sugar at $4\frac{1}{8}¢$ a pound? for selling 260 bags of flour at $1.05 a bag?

3. Mr. Teel sold his house for $14,500. He paid the salesman who found the purchaser for him a commission of $3\frac{1}{2}\%$. How much commission did the salesman receive?

4. An automobile agency receives a commission of 20% from the factory for selling cars. Last month they sold 56 cars at $1400 apiece. Find the total amount of the agency's commissions for the month.

5. If, in Ex. 4, the agency's expenses for the month were $12,456.78, how much profit was made that month?

6. On which would a salesman receive the greater amount of commission, a sale amounting to $1750 at 8%, or one amounting to $250 more than this at $7\frac{1}{2}\%$?

Find the amount of the commission earned in each case:

	Amount of Sale	Rate of Commission
7.	$275	9%
8.	$640	8%
9.	$1250	$7\frac{1}{2}\%$
10.	$1600	$12\frac{1}{2}\%$
11.	$2400	$16\frac{2}{3}\%$
12.	$3600	$33\frac{1}{3}\%$

	Amount of Sale	Rate of Commission
13.	$12,500	$4\frac{1}{4}\%$
14.	$15,000	$3\frac{1}{2}\%$
15.	$45,000	$2\frac{1}{2}\%$
16.	$1275.50	20%
17.	$1350.80	25%
18.	$2568.40	$37\frac{1}{2}\%$

1. Mr. West is a skilled mechanic. When he decided to change his job, he had his choice of four different positions. The first paid \$30 a week, the second \$5 a day, the third \$125 a month, and the fourth \$1600 a year. Taking 52 wk. or 304 working days to the year, find how much each position pays per year. Which one pays the most?

2. Mr. West took the job that paid \$30 a week, because he thought it offered the best chance for advancement. If he should receive an increase of 20% in the salary for this position, how much would he then earn per year?

3. Mr. Holt is considering a position that pays \$2080 the first year, with an increase of 15% the second year. What salary could he earn the second year in this position?

4. Miss Carter was offered a position at \$120 per month, with an increase of 10% the second year. How much in all could she earn the second year in this position?

5. Allowing 304 working days to the year, find how much per day is earned by a man who is paid \$2800 a year.

6. Mr. Green had a position in which he earned \$3200 a year. He took a salesman's job at \$50 a week plus a commission of $2\frac{1}{2}$% on his sales. How much commission did he have to earn in a year (52 wk.) in order to equal his old salary?

7. In Ex. 6, Mr. Green sold \$65,000 worth of goods one year. How much more than the \$3200 did he earn that year?

8. Mr. Rice is considering a salesman's position which pays a "straight commission" of 8%. His expenses, which he will have to pay himself, will average \$3800 a year. If he can sell \$125,000 worth of goods per year, how much will he have left for himself after paying his expenses?

1. When Fred Clarke left school, he started in to learn the dry-goods business "from the bottom up." He began in the shipping room at $12 per week. How much did he earn per year (52 wk.)?

2. Fred worked hard and "made good." During the second year he earned $18 a week. At this rate, how much did he earn per year?

3. The next year Fred went into the salesroom. He earned $25 a week there. How much did he then earn in 52 wk.?

4. In 2 yr. more his salary had increased to $35 a week. How much more per year was he earning than in Ex. 3?

5. Later Fred went "on the road" to sell goods to the dealers who bought from his company. His salary was $50 a week, and he also received a commission of 2% on his sales. His sales the first year were $54,650. How much did he earn in all that year?

6. Fred was still making good; his sales increased from year to year. The last year he was on the road his sales amounted to $172,000. How much did he make that year, including his salary of $50 per week and his commissions?

7. Fred is now sales manager of the company and directs the work of the other salesmen. His salary is $10,000 a year. How much is this per week? This is how much more per week than he made when he started (Ex. 1)?

1. When Fred Clarke's sister Kate finished her business course, Fred got her a position as a stenographer with the company where he worked. She was paid $20 a week at the start. How much did she earn per year (52 wk.)?

2. In 6 mo. Kate received an increase of 10%. How much did she then earn per year?

3. At the end of the next year, Kate received another increase of 10% in her salary. How much was she then earning per year? per week?

4. Kate was very accurate and businesslike, and she was soon promoted to a yearly salary of $1320. How much was she then earning per month? per week?

5. When Kate was receiving a salary of $1500 per year, how much was she earning per month? per week?

6. When Kate was put in charge of the entire office, they increased her salary of $1750 by 20%. How much was she then earning per year? per month?

7. When the president's private secretary left, Kate was given this position. She is now earning $2750 a year. How much is this per month? per week?

8. Kate's salary in Ex. 7 is how much more per week than when she began work (Ex. 1)?

1. "Old John" who runs a cobbler's shop has no regular salary, no commission, and no wages. He charges for each job by itself, and people come to him because he always does good work. On 7 repair jobs that he did yesterday he took in 50¢, $1.25, 75¢, $1.40, 60¢, $1.75, and $2. To how much did this amount in all?

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2. Old John also sells polish, shoe laces, and rubbers. In 6 da. last week he sold $24.90 worth of these articles. What was his daily average for the week?

3. John has only a small shop. It costs him $6.80 a day for rent, heat, light, and other expenses. Taking 25 business days to the month, find how much it costs per month.

4. Old John could make $6 a day in a shoe factory, working 8 hr. a day. He makes an average of $10 a day in his own shop, and even though he works 10 hr. a day he is "his own boss." How much more per hour does he make than he would make in the shoe factory?

5. Many workers in factories are paid "by the piece." At $\frac{3}{4}$¢ apiece, how much does a worker in a box factory receive for making 640 boxes?

6. A typist received 12¢ a page for copying a manuscript that contained 380 pages. It took her 10$\frac{1}{4}$ hr. How much on the average did she earn per hour?

1. Doctors, dentists, lawyers, and other professional men and women usually have no regular salary or commission. Dr. Carter averages 90 office visits at $2 each and 140 house calls at $3 each per month. His expenses average $125 per month. Deducting the expenses, how much on the average does he make per month?

2. In Ex. 1, how much more per year does he make than he would as house physician in a hospital at $3000 a year?

3. A lawyer is offered a salary of $4800 a year by an insurance company. His own law practice brings him an average of $600 a month, and his office expenses average $225 a month. Which work pays the more, and how much more, per year?

In the professional work deduct the expenses, and find in each case which work pays the more, and how much more, per year:

	Work at Regular Yearly Salary	Professional Work	
		Monthly Income	Monthly Expenses
4.	$3500	$450	$125
5.	$4500	$450	$100
6.	$5000	$525	$120

	Work at Regular Yearly Salary	Professional Work	
		Monthly Income	Monthly Expenses
7.	$5000	$675	$150
8.	$5500	$900	$350
9.	$7500	$1100	$385

HERE is part of a weekly pay roll of the Jimco Manufacturing Company. It shows the hours that 5 of the men worked. The regular working day is 8 hr., with 5 hr. on Saturdays, and overtime is paid at 50% more than the regular wage. After studying the pay roll, answer the questions below.

NAMES	M.	TU.	W.	TH.	F.	S.	HOURS WORKED	RATE PER HOUR	WAGES DUE
R. T. Ball	8	6	$7\frac{1}{2}$	$6\frac{1}{2}$	$7\frac{1}{4}$	4		60¢	
E. S. Cox	6	8	$7\frac{3}{4}$	$7\frac{1}{2}$	$7\frac{3}{4}$	5		$62\frac{1}{2}$¢	
F. K. Ham	10	8	8	6	8	4		80¢	
I. N. Lane	8	8	8	8	8	4		$87\frac{1}{2}$¢	
L. P. Ray	8	9	$7\frac{1}{2}$	10	8	9		75¢	
Totals								——	

1. How much did Mr. Ball earn on Monday? on Tuesday? on each of the other days? By adding, find how much he earned during the week.

2. How many hours did Mr. Cox work during the week? How much did he earn in all? Is this a better way to find the amount of wages due than the one in Ex. 1?

3. How many hours overtime did Mr. Ham work on Monday? To how much does this overtime amount? How much did he earn in all during the week?

4. How much did Mr. Lane earn in all during the week?

5. Watching for overtime, find Mr. Ray's earnings.

6. Copy the pay roll, fill in all the spaces that are left blank, and check your work. What is the total amount that the company must provide to pay these 5 men?

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. A factory packs salmon in cases of 4 doz. cans each. How many cases are needed in packing an order for 9600 cans?

2. At an average speed of $1\frac{1}{2}$ mi. an hour, how long will it take an ox team to go $8\frac{1}{2}$ mi.?

3. If a housekeeper should waste an average of 1 lb. $1\frac{1}{2}$ oz. of flour each month, how much would she waste in a year?

4. A meter is equivalent to 39.37 in. How many feet long is the 100-meter dash in the Olympic Games?

5. It is 285 mi. from Detroit to Chicago. At 3.6¢ a mile, what is the cost of a railroad ticket between these cities?

6. Jack worked $3\frac{1}{2}$ hr. at 30¢ an hour. How much more money does he need to buy a baseball costing $1.25?

7. Owing to bad weather a painter worked only 75% of the 304 working days one year. How many days did he work?

8. Mr. Green paid $7.50 for 12 hr. work on his lawn. How much was this per hour?

9. Last week Mr. Steele worked $7\frac{1}{2}$ hr., 8 hr., $6\frac{3}{4}$ hr., 7 hr., $8\frac{1}{2}$ hr., and 4 hr. How many hours did he work in all?

10. At one time the population of Chicago was 3,000,000, and the area of the city was approximately 200 sq. mi. What was the average number of people per square mile?

Review Practice

See how quickly you can do these multiplications:

1. 423 × 21	2. 500 × 60	3. 7432 × 48	4. 8096 × 35	5. 1798 × 79
6. 59.6 × 34	7. 4.78 × 69	8. 103.2 × 0.57	9. 9.687 × 1.5	10. 43.52 × 900

See if you can do all these divisions correctly:

11. $45\overline{)9045}$ 13. $69\overline{)2415}$ 15. $99\overline{)88.11}$ 17. $79\overline{)62.41}$

12. $52\overline{)6240}$ 14. $55\overline{)3465}$ 16. $89\overline{)9.701}$ 18. $96\overline{)40.80}$

See how long it takes you to do these examples:

19. $\frac{5}{8}+\frac{1}{2}$	23. $3\frac{3}{4}+2\frac{7}{8}$	27. $1\div 5\frac{2}{3}$
20. $\frac{5}{8}-\frac{1}{2}$	24. $3\frac{3}{4}-2\frac{7}{8}$	28. $2\frac{3}{8}\div 1\frac{3}{16}$
21. $\frac{5}{8}\times\frac{1}{2}$	25. $3\frac{3}{4}\times 2\frac{7}{8}$	29. $1\frac{3}{16}\div 2\frac{3}{8}$
22. $\frac{5}{8}\div\frac{1}{2}$	26. $2\frac{7}{8}\div 3\frac{3}{4}$	30. $1\frac{3}{16}\div 1\frac{3}{16}$

Copy these tables and fill the blank spaces:

	Fraction	Decimal	Per Cent
31.	$\frac{1}{2}$	____	50 %
32.	$\frac{1}{4}$	0.25	____
33.	$\frac{1}{5}$	____	____
34.	____	____	10 %
35.	____	0.40	____

	Fraction	Decimal	Per Cent
36.	$\frac{1}{3}$	$0.33\frac{1}{3}$	____
37.	____	____	$66\frac{2}{3}$ %
38.	$\frac{1}{6}$	____	____
39.	____	$0.37\frac{1}{2}$	____
40.	____	____	100 %

Getting Your Money's Worth

AFTER people have worked hard to earn money, you would naturally think that they would spend it wisely. But many people fail to do this, and frequently do not have enough money left for the things that they really need.

It is not always an easy thing to "get your money's worth."

1. George has earned 75¢. At 5¢ each, how many packages of gum can he buy with it? At 5 sticks to the package, how many sticks can he buy? Do you think that this would be a good way for George to spend all of his 75¢?

2. Kate earned 80¢ by taking care of the neighbor's baby. At 2¢ each, how many candy bars can she buy with it? If Kate should buy the bars, would the money be well spent?

3. After paying the rent, George's father had only $4 left. At 5¢ each, how many cigars could he buy with it? Do you think that he ought to spend the $4 this way?

4. Kate's sister has saved $10 and earns $9 a week. By paying $10 down and $7.50 a week for 4 wk., she can buy a radio set. How much will the set cost her? Do you think that under the circumstances this would be "a good buy"?

5. Mrs. Jones has saved $30 with which to buy a winter coat. She can get a warm plain wool coat for $30 or one made of much lighter and cheaper material, but with a fur collar, for $25. Which one should you advise her to buy?

6. Without giving any names, write a brief story telling about one or more cases where you do not think that the buyers got their money's worth. If you can, tell also of some case where you think the money was well spent.

Tell how these quotients were found:

1. $0.3\overline{)0.6}$ $\quad 2$	**2.** $4\overline{)2}$ $\quad 0.5$	**3.** $0.3\overline{)6}$ $\quad 20$	**4.** $8\overline{)6}$ $\quad 0.75$
5. $4\overline{)0.8}$ $\quad 0.2$	**6.** $0.03\overline{)0.06}$ $\quad 2$	**7.** $0.2\overline{)10}$ $\quad 50$	**8.** $0.03\overline{)6}$ $\quad 200$

Do these divisions, practicing on any examples with which you have difficulty:

9. $6\overline{)3}$	**10.** $0.3\overline{)9}$	**11.** $0.04\overline{)16}$	**12.** $5\overline{)1.5}$
13. $2\overline{)2.4}$	**14.** $0.9\overline{)4.5}$	**15.** $12\overline{)1.44}$	**16.** $7\overline{)0.035}$
17. $0.03\overline{)9}$	**18.** $0.05\overline{)45}$	**19.** $0.03\overline{)0.60}$	**20.** $0.08\overline{)3.2}$
21. $1.2\overline{)7.2}$	**22.** $9\overline{)0.027}$	**23.** $0.04\overline{)9.08}$	**24.** $0.003\overline{)6}$

See how quickly you can do these examples:

25. $\frac{1}{2} \div \frac{5}{8}$	**28.** $3\frac{3}{4} \div 2\frac{7}{8}$	**31.** $0 \div 5\frac{2}{3}$
26. $2\frac{1}{2} \times 38$	**29.** $17 \div 2\frac{1}{2}$	**32.** $7\frac{1}{2} \div 2\frac{1}{4}$
27. $4\frac{7}{8} + 3\frac{3}{4}$	**30.** $5\frac{1}{8} - 2\frac{3}{4}$	**33.** $22\frac{1}{2} \div 1\frac{1}{8}$

See if you can do these examples correctly:

34. 12.003 $+7.697$	**35.** 21.010 -9.470	**36.** 4.296 $\times 3.4$	**37.** $126\overline{)\$5387.76}$

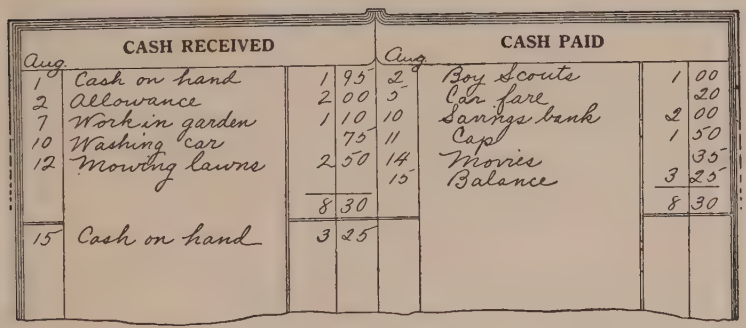
Find these per cents:

38. 6% of \$921.50	**42.** 8% of \$16.40
39. 5% of \$6.80	**43.** $1\frac{1}{2}$% of \$2.34
40. 2% of \$7900	**44.** 25% of \$114.80
41. $12\frac{1}{2}$% of \$176.80	**45.** $37\frac{1}{2}$% of \$125.60

ONE of the best ways to be sure that you are spending money wisely and at the same time saving for the future is to keep an accurate account of income and expenses.

Be sure to put down everything that you earn and spend.

Here is part of Dan Stone's cash account for August:



CASH RECEIVED				CASH PAID			
Aug.				Aug.			
1	Cash on hand	1 95		2	Boy Scouts	1 00	
2	Allowance	2 00		5	Car fare		20
7	Work in garden	1 10		10	Savings bank	2 00	
10	Washing car		75	11	Cap	1	50
12	Mowing lawns	2	50	14	Movies		35
				15	Balance	3	25
		8	30			8	30
15	Cash on hand	3	25				

Amounts received are always written on the left-hand page, and amounts paid out on the right-hand page.

1. In Dan's cash account, what is the sum of the five items on the left-hand side? of the first five items on the right? Why does the balance on Aug. 15 amount to $3.25?

2. Why does Dan write "Cash on hand, $3.25" on the left-hand side under date of Aug. 15?

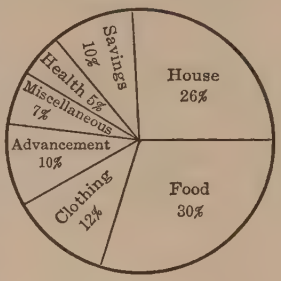
3. Using any items and dates that you wish, make out a cash account showing $8.76 on hand, receipts of $1.25, 35¢, $1.10, 65¢, and $4.50, and expenses of 85¢, $1.16, $1.20, 10¢, 50¢, and $2.75. Balance the account on the last date.

4. Make up and balance an account such as you might keep yourself. Give at least six items on each side.

Making a Budget

MRS. STONE is a careful housekeeper; she knows just what part of the family income should be spent for things like food, rent, heat, light, and clothing.

Each year she makes up a **budget**, which is simply a plan for spending systematically so as to live within one's income. This diagram, which is called a **circular graph**, shows the per cents of the yearly income that she allows for each purpose.



At the end of the year she compares what she has actually spent for each purpose with her estimate, and tries to improve the accuracy of her budget.

Careless spenders rarely have anything left for "a rainy day." It is a good plan to live "on a budget."

In solving the following problems take the yearly income of the Stone family as $3000:

1. The graph shows that 26 % of the yearly income is allowed for the running expenses of the house, which includes rent, heat, light, water, and miscellaneous expenses. How much is allowed per year for the house?

2. What is the total allowance for food? Taking 52 wk. to the year, how much is this per week?

3. In Ex. 2, if 25 % of the food allowance is spent for groceries, how much per month is allowed for meat, milk, fruit, vegetables, and the expenses of preparing the food?

4. What is the yearly allowance for clothing, which includes outer clothing, shoes, hats, underwear, and so on?

5. The allowance for advancement includes such expenses as education, books and magazines, travel, religion, and charity. What is the Stones' yearly allowance for these purposes?

6. How much is allowed per year for health, which includes recreation, doctors' and dentists' bills, and medicine?

7. The allowance for miscellaneous purposes provides for laundry, presents, unforeseen expenses, and the like. How much does Mrs. Stone allow per month for these items?

8. The Stone family is careful to make definite provision for regular savings. How much is allowed per year for savings?

9. One of the ways in which they save is by Mr. Stone's life insurance. He pays $154.70 a year for this. How much is left for other types of savings?

10. Mrs. Stone told her neighbor, Mrs. Hill, about her budget. The Hills' yearly income is $4200. If Mrs. Hill follows Mrs. Stone's budget, how much should she allow per year for each of the seven purposes listed in the graph?

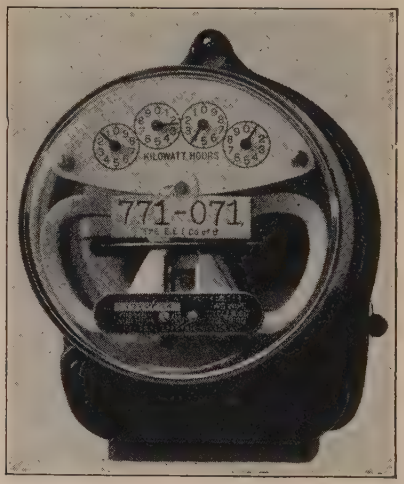
11. In buying things for the house, Mrs. Stone watches every chance to save. In July coal was $9.80 a ton and in October it was $10.75 a ton. How much did she save that year by buying their winter's supply of $7\frac{1}{2}$ T. in July?

12. The Stones' telephone bill last year was $36.80. If, by cutting down the number of calls, they save 20% this year, to how much does this saving amount?

13. Dishes and other things that are used in the kitchen and dining room are constantly being broken or wearing out. If Mrs. Stone allows 12% of their value per year to provide for replacing them, to how much does the allowance for replacement amount on a value of $270?

HERE is a picture of the meter which measures the amount of electricity that the Stone family uses in the house. Electricity is measured in **kilowatt hours (kw. h.)**, which means **1000 watts per hour.** For example, in 1 hr. a 50-watt lamp uses 50 watts, so that it will take 20 hr. to use 1 kw.

The dials in the picture show that 1241 kw. h. of electricity have already been used in the house.



1. Last month the Stones used 76 kw. h. of electricity. At 8¢ per kw. h., how much was the bill?

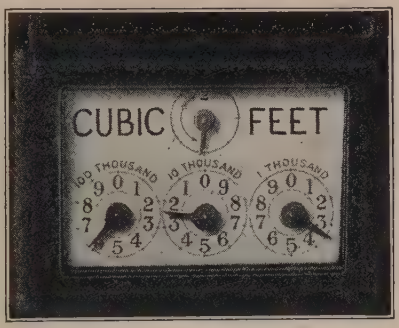
2. One month the electric meter read 1190 kw. h. and the next month it read 1282 kw. h. At 8¢ per kw. h., how much was the bill?

3. Mrs. Stone has a 600-watt electric flatiron. If she uses it 5 hr., how many kilowatt hours will the meter register? At 8¢ per kw. h., how much will the electricity cost?

4. The motor on Mrs. Stone's vacuum cleaner is marked 75 watts. At 8¢ per kw. h., what part of a cent does it cost per hour to run the cleaner?

5. Suppose that when going away for a 14-day vacation, you leave a 50-watt lamp burning. If the lamp burns all this time, how much will it cost at 10¢ per kw. h.?

THIS picture shows the dials on the gas meter in the Stones' house. Gas is measured by the cubic foot, and the cost is usually stated as so much per 1000 cu. ft.



The reading of this meter is 62,300 (cu. ft.), each dial being read as tenths of the unit marked above it.

If there is a gas meter in your home or in the school building, you should learn how to read it.

1. Last month Mrs. Stone used 2800 cu. ft. of gas for cooking. At $1.20 per 1000 cu. ft., how much was her bill?

2. One month the meter reading was 87,200 and the next month it was 92,400. At $1.20 per 1000 cu. ft., how much was the bill for the month?

3. In sections of the country where there is natural gas, the rates are much lower. At 35¢ per 1000 cu. ft., how much does a family have to pay for 9800 cu. ft. of natural gas?

Find the amounts that belong in the two blank columns:

	Present Meter Reading	Last Meter Reading	Amount Used	Cost per 1000 cu. ft.	Amount Due
4.	28,300	26,400		$1.20	
5.	31,400	27,900		$1.10	
6.	61,000	58,500		$1.40	
7.	73,200	70,700		$1.25	

WHETHER you live in a city, town, or village, one of the big items of expense is the **cost of shelter.** If you own your home, you have to pay for it and keep it in repair; if you hire a place in which to live, you have to pay rent.

1. Mr. Gray pays $45 a month for the rent of the house in which he lives. How much is this per year?

2. Mr. West pays $65 a month for the rent of an apartment in the city. If his rent is raised 10%, how much will it increase Mr. West's yearly cost of shelter?

Find the amount spent per year when the monthly rent is

3. $17.50 4. $27.50 5. $34 6. $67.50 7. $85

8. It is often said that rent should not exceed 25% of the yearly income. What is the largest monthly rental that a family with an income of $3600 a year should pay?

9. People who own houses have to **pay taxes** to the city or town in which they live, so as to help pay for the schools, the police and fire departments, roads, and the like. Mr. Starr's house and lot are valued at \$8200. If he pays $2\frac{1}{2}\%$ of this value each year in taxes, how much does he have to pay?

10. The value which the city or town places on a person's property is called the **assessed valuation.** It is often less than the actual value. In a town where the assessed valuation is 80% of the actual value, what is the assessed valuation of a house and lot that are actually worth \$12,500?

11. **Tax rates** are sometimes stated as so many mills on each dollar of assessed valuation. **A mill is 0.1¢.** A rate of 19 mills on \$1 is how much on each \$100? on each \$1000?

12. Mr. Waters owns a house on which the assessed valuation is \$6500. The tax rate is 22 mills on \$1. How much does he have to pay in taxes?

13. In a town where the tax rate is \$24.80 per \$1000, how much is the tax bill on property assessed at \$8500?

Find the amount of the tax bill when the assessed valuation and the tax rate are as follows:

14. \$3500, 12 mills on \$1

15. \$7500, 9.2 mills on \$1

16. \$12,000, \$2.40 per \$100

17. \$45,000, \$28.20 per \$1000

18. Mr. Reed bought a house for \$7500, paying \$1600 in cash and the rest in 5 equal installments a year apart. What is the amount of each installment?

19. It costs Mr. Reed \$100 a year for repairs, \$134.50 for taxes, and \$12.70 for insuring his house against fire. How much does he have to allow per month for these expenses?

IT IS very necessary that the water you drink be pure. Cities and towns often bring water long distances from reservoirs, and charge the owners of the houses either by the cubic foot or by the gallon for the water used.

1. Mr. Stone has to pay \$10 for the first 2500 cu. ft. of water used per year, and 13¢ per 100 cu. ft. for all used in excess of that amount. Last year he used 4900 cu. ft. of water in all. How much was his water bill?

2. There are $7\frac{1}{2}$ gal. to the cubic foot. At 8¢ per 1000 gal., how much does water cost per 1000 cu. ft.?

3. At \$1.20 per 1000 cu. ft., how much per month does a family pay for water in a year when 14,000 cu. ft. are used?

4. New York City uses an average of 900,000,000 gal. of water per day. Giving the answer as millions of gallons, find how much water is used per year (365 da.).

1. Mrs. Stone finds that **by watching for special sales** she can often save money in buying groceries. For example, the regular price of the butter that she buys is 55¢ a pound, but one day at a special sale the price was 51¢ a pound. How much could she save in buying $3\frac{1}{2}$ lb. at the sale price?

2. Bacon for which Mrs. Stone regularly pays 42¢ a pound was 36¢ a pound at the special sale. How much could she save on a strip of bacon that weighed $6\frac{1}{2}$ lb.?

Find the amount of saving on each of these purchases:

	Article	Amount Purchased	Regular Price	Price at Special Sale
3.	Soap . . .	12 bars	10¢ a bar	$8\frac{1}{2}$¢ a bar
4.	Cheese . .	$2\frac{1}{4}$ lb.	32¢ a pound	28¢ a pound
5.	Coffee . .	4 lb.	54¢ a pound	47¢ a pound
6.	Soups . .	2 doz. cans	$12\frac{1}{2}$¢ a can	9¢ a can

Buying in Quantity

1. Mrs. Stone can buy tomatoes at 22¢ a can, but if she buys 1 doz. at a time the price is $2.50 per dozen. How much can she save in buying by the dozen?

2. The price of flour is 6¢ a pound, or $1.35 for a bag that contains 24½ lb. How much can Mrs. Stone save on 24½ lb. of flour in buying by the bag instead of by the pound?

3. Mrs. Stone bought 1 doz. bottles of maple sirup for $6.25, instead of paying 60¢ a bottle. She estimated, however, that because there was plenty, the family used 2 more bottles than they would have if she had bought only a bottle at a time. Did she save or lose money in this case? How much?

4. Do you think that it would be a good plan to buy a quantity of something that is likely to spoil in keeping? Is a person likely to be more extravagant if there is a large quantity on hand? Write a brief statement telling about one case in which it would be a good plan to buy in quantity and one in which it would not.

Find the amount of saving in each of these cases in buying by the dozen, bag, or case:

	Article	Single Price	Quantity Price
5.	Bath towels . .	50¢ each	$5.40 per dozen
6.	Handkerchiefs .	35¢ each	$3.40 per dozen
7.	Sugar.	6¢ per pound	$1.10 per 25-pound bag
8.	Canned peaches	35¢ per can	$3.60 per dozen
9.	Canned beans .	24¢ per can	$4.65 per case (24 cans)
10.	Asparagus tips .	45¢ per can	$8.75 per case (24 cans)

AS SHE was passing the Modern Department Store, Mrs. Stone noticed some cards in the windows announcing that the store was having a **bargain sale** and that goods could be purchased at certain **per cents off**; that is, at certain per cents less than the prices regularly charged. Mrs. Stone went in to see if she could save money.

ANNUAL SPRING SALE
June 10 - June 15

Linens and dress goods	20% off
Ready-to-wear clothing	10% off
Furniture and rugs	$16\frac{2}{3}$% off

Stores often have sales like this so as to clear their shelves and make room for the new goods that they have ordered.

1. Mrs. Stone looked at a tablecloth, regularly sold for $6.50, that could now be bought at 20% less. How much could she save by buying it at the sale? How much would she have to pay for the tablecloth?

Find the amounts that belong in the last two columns:

	Article	Regular Price	Per Cent Off	Amount of Saving	Price at Sale
2.	Coat	$16.50	10%		
3.	Armchair	$42.00	$16\frac{2}{3}$%		
4.	Napkins (doz.) . .	$9.50	20%		
5.	Suit	$55.00	10%		
6.	Rug	$96.00	$16\frac{2}{3}$%		
7.	Dress	$18.50	10%		
8.	Bureau	$57.00	$16\frac{2}{3}$%		

Finding the Net Price

MERCHANTS often speak of selling an article **at 10% off** as selling it **at a discount of 10%.** The price which the customer pays, which is the regular price less the discount, is called the **net price.**

On page 35 you found the net price (sometimes called the **bargain price**) by subtracting the discount from the regular price. Before going further, answer these questions:

1. If from 1 apple you take $\frac{1}{4}$ of it, how many fourths of it are left? How much is $1 - \frac{1}{4}$?

2. If from \$10 you take $\frac{1}{5}$ of it, how many fifths of \$10 are left? How much is $\frac{4}{5}$ of \$10?

3. If from \$10 you take 12% of it, what per cent (how many hundredths) of \$10 is left? How much is 88% of \$10?

Mrs. Reed saw a dress, marked \$13.50, which could be bought that day at a discount of 12%. What was the net price of the dress?

If from 100% of the regular price you take 12%, you have 88% left; or, expressed as hundredths, $1.00 - 0.12 = 0.88$.

To find the net price, which is \$11.88, simply multiply \$13.50 by 0.88.

\$13.50
0.88
1 0800
10 800
\$11.8800

To find the net price, subtract the rate of discount from 1.00 and multiply the regular price by the result.

You should study each example and decide for yourself which is the easiest way to solve it. For example, at 10% off, it will probably be easier for you to find $\frac{1}{10}$ of the regular price mentally and then subtract. At 12% off, the way shown above will probably be easier.

Use your common sense, and take the way that you think will be easiest for you.

1. Mr. Lodge is buying a suit that is regularly sold at \$48. At $16\frac{2}{3}\%$ off, how much will he have to pay for it? Find the answer by taking $\frac{1}{6}$ of \$48 and then subtracting.

2. In Ex. 1, find the answer by taking $\frac{5}{6}$ of \$48. Which is the easier method for you?

3. In Ex. 1, you might have multiplied \$48 by $0.16\frac{2}{3}$ and then subtracted. Is this an easier method than that of Ex. 1?

4. In Ex. 2, you might have multiplied \$48 by $1.00 - 0.16\frac{2}{3}$, or $0.83\frac{1}{3}$. Is this an easier method than that of Ex. 2?

5. Which of the four methods in Exs. 1 to 4 do you think is the easiest one for you? Give reasons for your answer.

6. At a sale at which 15% off was given, Mrs. Wade bought a blouse originally marked \$5.40. How much did it cost her?

7. The Novelty Store is going out of business and is selling out its entire stock at a discount of 45%. How much will Mrs. Wade have to pay for a lamp originally priced at \$24?

8. Which is cheaper for the purchaser, an article marked \$14 and sold at a discount of 30%, or one marked \$12.80 and sold at a discount of 25%? How much cheaper is it?

In each of the following cases find the net price by the method that seems to you to be easiest for that example:

	Regular Price	Discount
9.	\$16	10%
10.	\$20	5%
11.	\$48	$33\frac{1}{3}\%$
12.	\$75	18%
13.	\$125	6%

	Regular Price	Discount
14.	\$2.50	20%
15.	\$6.20	10%
16.	\$18.50	8%
17.	\$1250	15%
18.	\$2400	$6\frac{1}{4}\%$

Buying Things for Camp

GEORGE is going to a boys' camp this summer. By watching for bargain sales, he finds that he can buy some of the things he needs at a discount, as shown in the list below:

Articles Needed	Regular Price	Discount
2 pr. flannel "shorts"	$1.75 a pair	10 %
2 sleeveless wool jerseys . . .	3.20 each	$12\frac{1}{2}$ %
2 pr. heavy sneakers	2.85 a pair	20 %
6 pr. wool stockings	.75 a pair	12 %
1 bathing suit	2.80	15 %
1 heavy sweater	4.50	12 %
$\frac{1}{2}$ doz. handkerchiefs	.10 each	10 %
3 wool blankets	4.50 each	$33\frac{1}{3}$ %

1. By buying at a discount, how much can George save on the entire list? What will be the total cost of the articles?

2. For hikes, George bought a pair of heavy shoes that were originally marked $6.50. At 20 % off, how much did he pay?

3. George also needed a rubber "poncho" to use when he sleeps out of doors. At one store he could buy one for $2.75 with 20 % off, and at another for $3.60 with $33\frac{1}{3}$ % off. Which was the cheaper price, and how much cheaper was it?

4. George bought a flashlight originally priced at $1.25, a Scout knife at $1.20, fishing tackle at $2.75, and a tennis racket at $3.75. On all these things he got a discount of 8 %. How much did they cost in all?

5. The railroad fare to camp was $4.90 each way. By buying a round-trip ticket, George saved 15 % of what it would have cost him to buy two single-trip tickets. How much did he pay for his round-trip ticket?

MANY stores allow reliable customers to **open an account** and to **charge** their purchases. That is, the customer does not pay when he gets the goods, but waits for the store to send a **bill**. This is usually sent at the end of each month.

Here is a sample bill such as is sent by large city stores:

CARTER, TAYLOR AND CO.
112-124 West Street
DES MOINES, IOWA

Mrs. T. J. White
1162 Hillside Road
Des Moines, Ia.

Date Nov. 1, 19–
Account No. 7386
Amount, $ 23.55

Detach and send with payment. Your check is your receipt.

CARTER, TAYLOR AND CO. **CHARGES FOR MONTH OF** October

Oct.	4	2 pr. stockings	@ 1.75	3	50		
		1 sweater		6	50		
	15	1 pr. shoes		8	25		
	24	2 shirts	@ 2.65	5	30		
						23	55

A charge account is a good way to make purchases if

1. You can get as low a price as by paying cash;
2. You have the money to pay the bill promptly;
3. You are not tempted to buy things you do not need.

> **The only fair thing to do is to pay bills promptly. Do not get a reputation for being "poor pay."**

You learned about paying bills by bank checks last year. In order to get the money for the check, the merchant has to put his name on the back of it, which shows that he has received the money. The check is therefore a **receipt.**

Making out Bills

IN THE work below, you can use the names and addresses of anyone you wish, or you can make up some. Use the form of bill on page 39 unless you know of some better one.

In making out bills, $\frac{1}{2}$¢ or more in a computation should be taken as the next larger cent. Disregard anything less than $\frac{1}{2}$¢.

Make out the monthly bills for the following purchases:

1. May 5, 2 pr. shoes @ $5.50 (that is, at $5.50 per pair); May 7, 1 sport jacket @ $7.50; May 25, $\frac{1}{2}$ doz. handkerchiefs @ $2.50 per dozen; May 28, 2 blouses @ $1.45.

2. Apr. 10, 2 kettles @ $1.15 and $\frac{3}{4}$ doz. tumblers @ $1.80; Apr. 20, 3 saucepans @ 86¢; Apr. 25, 1 frying pan @ $1.65.

3. May 12, 1 tablecloth @ $5.75; May 22, 2 doz. towels @ $2.85; May 27, $5\frac{1}{4}$ yd. dress goods @ $1.65.

4. Mar. 8, $2\frac{1}{2}$ yd. ribbon @ 52¢ and 3 doz. buttons @ 24¢; Mar. 14, $3\frac{1}{2}$ yd. silk @ $2.45; Mar. 20, $1\frac{5}{8}$ yd. lining @ 65¢.

5. June 2, 4 doz. eggs @ 52¢; June 5, $3\frac{1}{2}$ lb. pork @ 28¢; June 7, 5 lb. sugar @ $6\frac{1}{2}$¢; June 10, $5\frac{1}{4}$ lb. beef @ 34¢; June 18, 4 lb. butter @ 41¢; June 22, 2 doz. oranges @ 54¢.

6. Aug. 5, 1 suit @ $45; Aug. 8, 4 shirts @ $1.85; Aug. 15, 6 pr. golf stockings @ $1.35; Aug. 22, 3 pr. pajamas @ $1.90; Aug. 25, 2 dresses @ $6.75; Aug. 30, 1 hat @ $4.50.

7. Oct. 1, $1\frac{3}{4}$ lb. sausages @ 36¢; Oct. 5, $2\frac{1}{2}$ lb. butter @ 48¢; Oct. 10, 2 boxes corn flakes @ 16¢; Oct. 14, 3 bags flour @ $1.30; Oct. 29, $2\frac{1}{2}$ doz. eggs @ 65¢.

8. Sept. 5, 6 spark plugs @ 65¢ and 1 tire gauge @ $1.10; Sept. 10, 2 tire casings @ $11.40 and 2 inner tubes @ $3.60; Sept. 25, 1 trunk carrier @ $9.75.

IF ANY question is likely to arise as to whether or not you have paid what you owe, there should be a written record to show that the money was paid. Here are three common ways of securing a **receipt** for money paid:

1. In paying cash, a signed acknowledgment of the receipt of the money may be written across the face of the bill. Business houses commonly use a stamp for this purpose, as here shown. The initials are those of the person who receives the money.

RECEIVED PAYMENT
Nov. 12, 19—
CARTER, TAYLOR AND CO.
By E. K. R.

2. In paying by check, the fact that the one to whom the check is payable has to sign his name across the back, as explained on page 39, shows that the money was received.

3. In paying cash where there is no written bill, a receipt in some such form as this one should be secured.

$ 4.25 Albany, N. Y., May 12, 19—
RECEIVED OF E. L. Hart
Four and 25/100 Dollars
for 8½ hr. labor on lawn.
Tony Ricardo

Using any names and dates you wish, write a receipt for

1. $1.50 paid for a subscription to a school magazine.
2. 7 hr. work in a garden at 55¢ per hour.
3. $5\frac{1}{2}$ hr. labor repairing a car at $1.25 per hour.
4. $15 paid on account (in part) on a loan made Oct. 18.
5. $12\frac{1}{2}$ hr. labor building a garage at $1.35 per hour.
6. $3\frac{3}{4}$ hr. labor repairing water pipes at $1.50 per hour.

Buying on the Installment Plan

MANY things today are sold **on the installment plan.** Under this plan, the purchaser pays part of the price "down" (at once) and the rest in weekly or monthly payments.

Sometimes it is a good plan to buy things this way and sometimes not. It enables people to use and enjoy things while they are earning the money to pay for them. On the other hand, things usually cost more when bought this way, and many people are tempted to buy things that they cannot afford.

Before agreeing to buy anything on the installment plan, be sure that your income will justify it.

---

1. Mr. Ware, a traveling salesman, needs a car for business use. The one that he wants costs $750 cash, or he can pay $300 down and the rest in 12 monthly payments of $42.50 each. How much more will the car cost by the second plan?

2. In Ex. 1, if Mr. Ware can earn $50 more a month by having the car, do you think that it would be a good plan to buy it?

3. Mrs. Starr can buy an electric washing machine for $75 cash, or for $20 down and 6 monthly payments of $10.50 each. How much more will it cost by the installment plan?

4. Because Mr. Holmes has been out of work, he is having a hard time to pay his bills. He can buy a radio set for $5 down and 10 weekly payments of $4.50 each. How much will it cost? Do you think that he ought to buy it?

5. Mr. West bought a car, paying $200 down and agreeing to pay 12 monthly installments of $58.50 each. After paying the third installment, he was unable to pay the rest. The dealer took back the car, and Mr. West lost all that he had paid. How much did he lose?

See how quickly you can find the net prices in these cases:

	Regular Price	Discount	Net Price
1.	$12	$\frac{1}{6}$	
2.	$24	$\frac{1}{4}$	
3.	$25	$\frac{2}{5}$	
4.	$100	$\frac{1}{5}$	
5.	$200	$\frac{1}{8}$	
6.	$30	6%	
7.	$80	$12\frac{1}{2}$%	
8.	$60	$16\frac{2}{3}$%	
9.	$400	10%	
10.	$450	4%	
11.	$200	20%	
12.	$580	50%	

	Regular Price	Discount	Net Price
13.	$1.50	$\frac{1}{2}$	
14.	$6.60	$\frac{1}{3}$	
15.	$4.80	$16\frac{2}{3}$%	
16.	$5.80	25%	
17.	$70.00	4%	
18.	$6.40	50%	
19.	$3.60	$\frac{1}{3}$	
20.	$36.00	$33\frac{1}{3}$%	
21.	$24.60	$16\frac{2}{3}$%	
22.	$44.20	20%	
23.	$56.50	8%	
24.	$68.40	15%	

In each of these cases, one product in the second column is correct. Without multiplying, pick out the correct one:

	Example	Product			
25.	$24 \times \$20.79$	$49.896	$4.9896	$498.96	$4989.60
26.	3.7×3.402	1.25874	125.874	1258.74	12.5874
27.	0.42×54.36	0.228312	22.8312	228.312	2.28312
28.	5.5×70.29	386.595	3.86595	3865.95	38659.5
29.	0.82×2.078	17.0396	1.70396	170.396	1703.96
30.	0.35×9.555	33.4425	334.425	3.34425	3344.25

Practice in Fractions

IF YOU have any difficulty with any of the work on this page, talk it over with your teacher so that you can learn how to avoid making the same mistakes in the future.

Do these common types of additions with fractions:

1. $\frac{1}{2}$	2. $\frac{3}{4}$	3. $\frac{1}{8}$	4. $\frac{5}{8}$	5. $4\frac{1}{2}$	6. $5\frac{2}{3}$
$\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{7}{8}$	$3\frac{7}{8}$	$2\frac{2}{3}$

Do these more unusual types of additions:

7. $\frac{1}{2}$	8. $\frac{3}{4}$	9. $\frac{1}{4}$	10. $\frac{1}{2}$	11. $1\frac{5}{12}$	12. $2\frac{4}{5}$
$\frac{1}{3}$	$\frac{1}{3}$	$\frac{2}{3}$	$\frac{2}{5}$	$2\frac{2}{3}$	$3\frac{1}{2}$

Do these common types of subtractions with fractions:

13. $\frac{7}{8}$	14. $\frac{5}{8}$	15. $\frac{3}{4}$	16. $\frac{3}{4}$	17. $3\frac{1}{3}$	18. $7\frac{1}{2}$
$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{8}$	$1\frac{2}{3}$	$3\frac{7}{8}$

Do these more unusual types of subtractions:

19. $\frac{1}{2}$	20. $\frac{2}{3}$	21. $\frac{3}{4}$	22. $\frac{7}{8}$	23. $4\frac{1}{4}$	24. $7\frac{5}{12}$
$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{2}{3}$	$1\frac{3}{5}$	$2\frac{1}{3}$

Do these multiplications:

25. $2\frac{1}{2} \times 16$	27. $\frac{7}{8} \times \frac{3}{4}$	29. $2 \times \frac{3}{4} \times 16$
26. $3\frac{3}{4} \times \$48$	28. $\frac{5}{12} \times \frac{4}{5}$	30. $\frac{3}{8} \times \frac{2}{3} \times 1\frac{4}{5}$

Do these divisions:

31. $15 \div \frac{3}{4}$	33. $25 \div 1\frac{1}{4}$	35. $2\frac{7}{8} \div 1\frac{3}{4}$
32. $\frac{3}{4} \div 15$	34. $6\frac{1}{4} \div \frac{3}{4}$	36. $12\frac{3}{4} \div 2\frac{1}{2}$

Interest for a Year

JUST as the farmer makes his horses and tractors work, or the housewife makes her sewing machine work, so **the thrifty man makes his money work and bring him an income.** One way is to make his savings draw **interest**, which means that someone will pay him for the use of his money.

Interest is usually paid as a certain per cent per year (called the **rate**) on the amount borrowed (called the **principal**). Unless otherwise stated, "interest at 6%" means 6% for 1 yr.

For example, if a man has saved $200 and lends it to someone who will pay him interest at 6%, the amount of interest that the $200 will earn in 1 yr. is $12, as shown in the work at the right.

$200	← Principal
0.06	← Rate of interest
$12.00	← Interest for 1 yr.

Interest for 1 yr. = principal × rate.

1. If a man lends $1500 to someone who pays him interest at 5%, how much income does his money earn per year?

Find the interest for 1 yr. when the principal and the rate of interest are as follows:

2. $1800, 6%
3. $2700, 4%
4. $2400, $4\frac{1}{2}$%
5. $3200, $5\frac{1}{4}$%
6. $250, 6%
7. $375, 4%
8. $500, 3%
9. $860, $2\frac{1}{2}$%
10. $275, 5%
11. $600, $4\frac{1}{4}$%
12. $800, $5\frac{3}{4}$%
13. $750, $6\frac{1}{2}$%

Interest for Part of a Year

IN THE work on page 45, the period, or **time**, for which the interest was computed was always 1 yr. Common sense tells you that the interest for 6 mo., or $\frac{1}{2}$ yr., would be $\frac{1}{2}$ that for 1 yr., the interest for 4 mo. would be $\frac{1}{3}$ that for 1 yr., and so on for other fractions of a year.

For example, to find the interest on \$1200 at 5% for 8 mo., first find the interest for 1 yr., as here shown. Then, since 8 mo. $= \frac{2}{3}$ yr., take $\frac{2}{3}$ of the interest for 1 yr.

\$1200	← Principal
0.05	← Rate of interest
\$60.00	← Interest for 1 yr.
$\frac{2}{3}$	← Time
\$40.00	← Interest for 8 mo.

The answer is \$40.

In such simple cases do the work mentally and write only the answer.

Taking "time" as meaning either the number of years or some fraction of a year, the rule for finding interest is

Interest = principal × rate × time.

In an answer, $\frac{1}{2}¢$ or more should be taken as the next larger cent. Disregard anything less than $\frac{1}{2}¢$.

Remember to write time given in months as a fraction of 1 yr.

Find the amount of interest due when the principal, rate, and time are as follows:

1. \$400, 6%, $\frac{1}{2}$ yr.
2. \$800, 5%, $\frac{1}{4}$ yr.
3. \$200, 7%, $\frac{3}{4}$ yr.
4. \$600, 4%, $\frac{1}{2}$ yr.
5. \$700, $4\frac{1}{2}$%, $\frac{1}{2}$ yr.
6. \$2500, 6%, 4 mo.
7. \$1600, 4%, 8 mo.
8. \$3200, 5%, 9 mo.
9. \$4800, $5\frac{1}{4}$%, 5 mo.
10. \$3600, 8%, 11 mo.

IN FINDING the interest on \$1600 at 6% for 2 yr. 3 mo., the time is more than 1 yr. The rule on page 46 can be applied if the time is first expressed as a mixed number. In this case,

Principal = \$1600
Rate = 6% = 0.06
Time = $2\frac{3}{12}$ yr. = $2\frac{1}{4}$ yr.

As here shown, the answer is \$216.

\$1600	\$96
0.06	$2\frac{1}{4}$
\$96.00	24
	192
	\$216

1. When he bought his house, Mr. Barnes owed \$2400 on which he agreed to pay interest at 6%. If he paid what he owed at the end of 1 yr. 9 mo., how much was the interest? How much did he pay, including principal and interest?

2. Rob Jones borrowed \$800 from his uncle so that he could finish college. If he pays it back at the end of 2 yr. 8 mo., with interest at $4\frac{1}{2}$%, how much will he pay in all?

Find the amount of interest due when the principal, rate, and time are as follows:

3. \$600, 5%, $2\frac{1}{2}$ yr.
4. \$350, 6%, $1\frac{1}{4}$ yr.
5. \$500, 5%, $2\frac{1}{4}$ yr.
6. \$900, 4%, $1\frac{3}{4}$ yr.
7. \$1500, $5\frac{1}{2}$%, 2 yr. 6 mo.
8. \$2400, $4\frac{1}{2}$%, 1 yr. 9 mo.
9. \$3200, $6\frac{1}{4}$%, 2 yr. 3 mo.
10. \$4800, $5\frac{3}{4}$%, 2 yr. 10 mo.

Find the sum of the principal and interest, when the principal, rate, and time are as follows:

11. \$750, $5\frac{1}{2}$%, $1\frac{1}{3}$ yr.
12. \$950, $4\frac{3}{4}$%, $2\frac{5}{6}$ yr.
13. \$6200, $4\frac{1}{2}$%, 3 yr. 9 mo.
14. \$8400, $5\frac{1}{2}$%, 2 yr. 7 mo.

Rule of Products and Factors

AS YOU already know, in $2 \times 3 = 6$ the 2 and 3 are called the **factors** of the product 6. There is a very useful rule about **products and factors** that will help you in solving certain types of problems. First answer these questions:

1. What is the product of 2×4? 8 is the product of 2 and what other number?

2. 24 is the product of 4 and what other number?

3. 30 is the product of 15 and what other number? How did you find the answer?

Dividing the product of two numbers by one of the numbers gives the other number.

For example, in finding of what number \$125 is $\frac{1}{5}$, you have

$$\$125 = \tfrac{1}{5} \times \text{some number.}$$

The answer is $\$125 \div \frac{1}{5}$, or $\$125 \times \frac{5}{1}$, which is \$625.

---

1. 96 is the product of 6 and what other number? of 4 and what other number? How did you find the answers?

Find the numbers that belong in the last column in each table:

	Product of Numbers	One Number	Other Number
2.	840	40	
3.	24.8	8	
4.	3.75	$\frac{1}{2}$	
5.	150	$\frac{1}{5}$	
6.	750	$\frac{2}{5}$	

	Product of Numbers	One Number	Other Number
7.	\$1200	\$300	
8.	\$12	\$72	
9.	\$400	\$400	
10.	\$960	$\frac{1}{3}$	
11.	\$36.24	$\frac{1}{8}$	

ONE of the ways in which you will make the most use of the rule on the opposite page is in **finding what per cent one of two numbers is of the other.**

For example, if 16 pupils in a school of 480 pupils are absent today, what per cent of the school is absent?

In this case, you know that

$$16 = \text{some per cent} \times 480.$$

Which number is the given product? Which one of the two factors of this product is known? How can you find the other factor?

$$480\overline{)16.0} = 0.03\tfrac{16}{48} = 0.03\tfrac{1}{3}$$

$$\begin{array}{r} 144 \\ \hline 16 \end{array}$$

Expressing $0.03\frac{1}{3}$ as a per cent, the answer is $3\frac{1}{3}\%$.

To find what per cent the first of two numbers is of the second, divide the first by the second, expressing the quotient first as hundredths and then with the per-cent sign.

Study these two examples and be sure you understand them:

(1) $\frac{1}{2} \div 2 = \frac{1}{4} = 25\%$ — $\frac{1}{2}$ is 25% of 2

(2) $125 \div 125 = 1.00 = 100\%$ — 125 is 100% of 125

Every number is 100% of itself.

Find what per cent the first number is of the second:

1. 20, 80	5. 20, 150	9. 75, 325	13. 14, 14
2. 30, 90	6. 60, 300	10. $12\frac{1}{2}$, 100	14. 100, 100
3. 40, 50	7. 45, 900	11. $12\frac{1}{2}$, 75	15. 200, 200
4. 100, 200	8. 150, 300	12. 50, 400	16. 350, 700

Another Per-Cent Problem

HERE is another way in which you can use the Rule of Products and Factors. For example, suppose that Mr. Jones has a chance to invest some money so that it will draw interest at 6%. How much must he invest in order to get an income of $1200 a year?

$$0.06\overline{)\$1200.00}$$
$$\$20000.$$

In this case, you know that

$\$1200 = 0.06 \times$ some number.

Dividing by 0.06 as shown above, the answer is $20,000.

To find the number of which a given number is a given per cent, divide the given number by the per cent.

---

1. $75 is 5% of what amount? 15% of what amount?

2. $80 is 25% of what amount? Since $25\% = \frac{1}{4}$, what is the easiest way of finding the answer?

3. How much money will have to be put into an investment that draws interest at 6% in order to get from it an income of $750 per year?

4. On his last arithmetic test John had a mark of 80%. He had **16** answers right. How many examples were there in all?

Find the number of which

5. 24 is 2%
6. 16 is 8%
7. 56 is 7%
8. 90 is 9%
9. 1.8 is 2%
10. 4.9 is 7%
11. $200 is 10%
12. $450 is 9%
13. $750 is $33\frac{1}{3}$%
14. $1250 is 5%
15. $1800 is 6%
16. $2400 is 24%
17. $21.60 is $4\frac{1}{2}$%
18. $29.61 is $5\frac{1}{4}$%
19. $143.75 is $5\frac{3}{4}$%
20. $390.00 is 6%
21. $1000.00 is 8%
22. $592.80 is $4\frac{3}{4}$%

1. After he leaves high school, Ted Moore wants to go to college. With what he can earn there, it will cost about $600 a year. Ted and his father are saving money so that when Ted is ready to go the interest at 5% will amount to $600 a year. How much will they have to save?

2. Mr. Howard has saved $18,000. What per cent of interest, to the nearest 0.1%, will he have to receive on this money to get from it an income of $1000 a year?

3. A hospital is trying to raise money which is to be invested so as to yield a yearly income that will help to pay the running expenses. If the average rate of interest received is 5%, how much will have to be raised in order to get from it a yearly income of $10,000?

4. A college raised $500,000 and invested it in such a way that the yearly income was $26,250. What was the average per cent of interest at which the money was invested?

Find the amount that must be invested at $4\frac{3}{4}\%$ so as to produce a yearly income of

5. $57 6. $95 7. $285 8. $356.25 9. $783.75

Find the numbers that belong in the blank spaces:

	Amount Invested	Per Cent	Yearly Income
10.	$7500	4%	$____
11.	$____	5%	$375
12.	$7500	___%	$450
13.	$____	7%	$385

	Amount Invested	Per Cent	Yearly Income
14.	$8000	___%	$360
15.	$____	$5\frac{1}{4}\%$	$472.50
16.	$8500	$5\frac{1}{4}\%$	$_____
17.	$8750	___%	$393.75

What You have Cost

IF YOU remain in school until you have finished high school, **you will have cost a great deal of money.** Part of this is paid by your parents, part by the government which runs the schools to which you go, and perhaps part of it by what you earn yourself. These figures show how much, on the average, has been spent by the time you have finished high school:

Item	Amount	Item	Amount
Food	$2500	Health and recreation	$660
Clothing and shelter	3400	Insurance on house .	50
Education	1150	Miscellaneous	640

The amounts in the table are called **round numbers**, which are numbers that are only approximate. In this case the amounts have been "rounded off" to the nearest $10.

1. What is the average total cost of a child from birth until he has finished high school? Are you worth it?

2. In Ex. 1, if the child is 18 yr. old when he finishes school, how much, to the nearest $10, is the average cost per year?

3. In Ex. 2, how large an amount of money would have to be invested at 5% to meet the average yearly cost?

In Exs. 4 to 6 find the answers to the nearest 1%:

4. The cost of food is what per cent of the total cost?

5. What per cent of the total cost is required to keep you well and happy (health and recreation)?

6. What per cent of the total cost is required for clothing and shelter? for education? for miscellaneous expenses?

YOU have already learned how to find a missing factor when the product of **two** numbers and **one** of the numbers (factors) are given. In some problems, as on page 54, a given number may be the product of **more than two** factors.

Study the work below. It shows in (1) an easy way of finding the missing factor when it is given that

$$30 = 2 \times 3 \times \text{some number}.$$

In (2) it shows how to find the missing factor in the case of

$$60 = 3 \times \text{some number} \times 5.$$

(1) $\dfrac{\cancel{10}\ 5\ \cancel{30}}{\cancel{2} \times \cancel{3}\ \ 1\ \ 1} = 5 \leftarrow \textit{Ans.}$

(2) $\dfrac{\cancel{20}\ 4\ \cancel{60}}{\cancel{3} \times \cancel{5}\ \ 1\ \ 1} = 4 \leftarrow \textit{Ans.}$

Of course, you can easily guess these factors, but with larger numbers it will be easier to divide as shown above.

Always cancel when you can in such work. It saves time.

---

1. Tell how to find the missing factor when you are given a product and three of the four factors.

2. In $125 = 5 \times 5 \times$ some number, find the missing number.

Find the number that belongs in place of each star (*):

3. $32 = 2 \times 4 \times (*)$
4. $45 = 3 \times 5 \times (*)$
5. $60 = 2 \times (*) \times 5$
6. $625 = (*) \times 5 \times 25$
7. $\$120 = 2 \times (*) \times \$2000$
8. $\$270 = \$3000 \times 0.06 \times (*)$

Finding the Rate of Interest

WHILE checking up his accounts, Mr. Jones finds that on an investment of $1600 which he made 3 yr. ago, he has received a total of $240 in interest. At what rate of interest was the money invested?

Since **Interest = principal × rate × time,**

in this case, $\$240 = \$1600 \times \text{rate} \times 3$.

Here the product is $240, the given factors are $1600 and 3, and the missing factor is the rate. In this case, therefore,

$$\text{Rate} = \frac{\$240}{\$1600 \times 3}.$$

Canceling as shown at the right, the answer is $\frac{1}{20}$, or 5%.

$$\frac{\overset{1}{\cancel{\$240}}}{\underset{20}{\cancel{\$1600}} \times \underset{1}{\cancel{3}}} = \frac{1}{20} = 5\%$$

$$\textbf{Rate} = \frac{\textbf{interest}}{\textbf{principal} \times \textbf{time}}.$$

Remember that **"time" must always be stated in years.** Use fractions as necessary for parts of a year, as in $\frac{3}{4}$ yr. or $2\frac{1}{2}$ yr.

---

1. Mr. Jones wishes to invest $1800 so that it will bring him $225 in 2 yr. 6 mo. What number represents the time in this case? What will the rate of interest have to be?

Find the numbers that belong in the blank column:

	Principal	Rate	Interest	Time
2.	$700		$52.50	1 yr. 3 mo.
3.	$960		$105.60	2 yr. 9 mo.
4.	$1200		$150.00	2 yr. 6 mo.
5.	$1500		$112.50	1 yr. 3 mo.

HERE is another kind of problem that Mr. Jones sometimes has to solve in connection with his investments. For example, he may need to know how long it will take $1500 to earn $360 in interest if invested at 6%.

If in **Interest = principal × rate × time,**

the missing factor is "time," it is easy to see, as in finding the rate on page 54, that

$$\text{Time} = \frac{\text{interest}}{\text{principal} \times \text{rate}}.$$

In the problem given above, you can therefore think

$$\text{Time} = \frac{\$360}{\$1500 \times \frac{6}{100}}.$$

$$\frac{\cancel{360}^{\,4}}{\cancel{1500}_{\,\cancel{15}\;1}} \times \frac{\cancel{100}^{\,1}}{\cancel{6}_{\,1}} = 4$$

Using cancellation, as shown in the work above, the answer is 4. Since "time" is always stated in years, this means 4 yr.

1. Mr. Jones sold some property for $40,000 and invested the money at 5%. How long will it be before the sum of the principal and the interest amounts to $50,000?

Find the numbers that belong in the blank column:

	Principal	Rate	Interest	Time
2.	$750	4%	$45.00	
3.	$1260	5%	$63.00	
4.	$2400	6%	$324.00	
5.	$18,500	5%	$2312.50	

1. Jerry and his brother Ray each raised a pure-bred calf. When they sold the calves, they got \$100 apiece for them. Jerry put his \$100 in the bank where it earned interest at $4\frac{1}{4}\%$. How much income will he get per year from his \$100?

2. Ray took his \$100 and bought pigs and corn. At the end of a year he sold the pigs for \$115. What per cent did he get on his \$100?

3. Joe Cobb needs \$50 to build a hot-dog stand on the state road in front of the house. If he borrows the money for 6 mo. at $5\frac{1}{2}\%$, how much interest will he have to pay? How much, to the nearest 1¢, will he have to put aside each month to pay the principal and interest at the end of the 6 mo.?

Find the numbers that belong in the blank spaces:

	Principal	Rate	Time	Interest
4.	\$125.00	4%	4 mo.	\$_____
5.	\$275.00	_____%	$2\frac{1}{2}$ yr.	\$27.50
6.	\$350.00	$5\frac{1}{2}\%$	____ yr.	\$19.25
7.	\$_____	6%	6 mo.	\$210.00
8.	\$7200.00	_____%	$\frac{1}{2}$ yr.	\$270.00
9.	\$275.50	4%	____ yr.	\$38.57
10.	\$_____	$4\frac{1}{2}\%$	3 yr.	\$195.75

Saving in Small Amounts

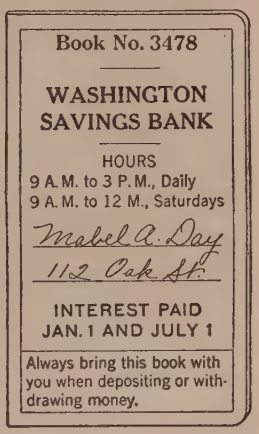
PEOPLE no longer have to hide their savings. They can put them in a bank, where the money will not only be safe but will also earn interest and thus bring them an income.

Here is a picture of Mabel Day's savings-bank book. Her money earns 4% a year. Mabel has learned that

Saving money is just as important as earning it.

A cent is not much; but if Mabel saves 1¢ a day, she will have $3.65 at the end of a year.

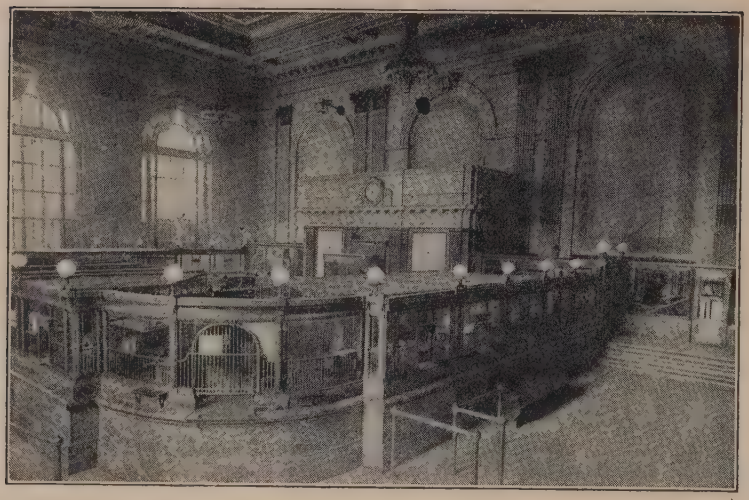
A man who saves $2 a day will have $730 at the end of a year, and if he puts it in the bank as he saves it, he can add the interest that it earns to what he saves.


Book No. 3478
WASHINGTON SAVINGS BANK
HOURS
9 A.M. to 3 P.M., Daily
9 A.M. to 12 M., Saturdays
Mabel A. Day
112 Oak St.
INTEREST PAID JAN. 1 AND JULY 1
Always bring this book with you when depositing or withdrawing money.

1. If, beginning today, you save 25¢ a day, how much will you have on the day you are 21 yr. old? Take 365 da. to the year and do not count any interest.

Taking 52 wk. to the year and disregarding interest, find the total amount saved when the amount per week and the length of time are as follows:

2. 20¢, 1 yr.
3. 50¢, $\frac{1}{2}$ yr.
4. 75¢, $\frac{3}{4}$ yr.
5. $2, 2 yr.
6. $5, 1 yr.
7. $7, $1\frac{1}{2}$ yr.
8. $8, $2\frac{1}{4}$ yr.
9. $3, 5 yr.
10. $10, 2 yr.
11. $15, $2\frac{1}{2}$ yr.
12. $20, 6 mo.
13. $40, $3\frac{1}{2}$ yr.



WHEN Mabel **opened her account** at the savings bank, she put in $1. The **teller,** or clerk, wrote the amount in her bank book (see page 57), which is often called a **pass book.** Whenever Mabel **deposits** (puts in) or **draws out** money, the amount is entered in her book.

The bank pays Mabel interest every 6 mo. on the smallest amount, **disregarding the cents,** that has been on deposit in her account during the previous 6 mo.

Mabel has the bank add the interest to her account, and the new amount draws interest for the next 6 mo.

When interest as it comes due is added to the principal and the whole amount draws interest for the next period, the interest is called compound interest.

This is different from the kind you have been studying, which is called **simple interest** in order to distinguish it.

HERE is an example showing how the compound interest on a deposit of $1000 can be found for 2 yr. when the rate is 4% a year and the interest is paid every 6 mo.

Study the example carefully, noticing particularly that the **cents in the principal are disregarded in finding the interest due every 6 mo.** The bank does this.

After studying the work, do the example yourself and be sure you understand it all.

$1000	← first principal
× 0.02	← rate for $\frac{1}{2}$ yr.
$20	← int. first 6 mo.
+ 1000	← first principal
$1020	← bal. after 6 mo.
× 0.02	
$20.40	← int. on $1020
+ 1020.00	← previous bal.
$1040.40	← bal. after 1 yr.
× 0.02	
$20.80	← int. on $1040
+ 1040.40	← previous bal.
$1061.20	← bal. after $1\frac{1}{2}$ yr.
× 0.02	
$21.22	← int. on $1061
+ 1061.20	← previous bal.
$1082.42	← bal. after 2 yr.
− 1000.00	← first principal
$82.42	← compound interest

1. How much simple interest would $1000 earn in 2 yr. at 4%?

2. In Ex. 1, how much more is the compound interest?

3. Find the simple interest on $2000 for 2 yr. at 6% and also the compound interest for 2 yr. at 6%, payable semiannually; that is, every 6 mo. How much more is the compound interest?

4. If you reinvest simple interest as it comes due, you get compound interest. If $10,000 is invested at 6%, and the interest is reinvested at 6% at the end of each year, to how much will the $10,000 amount in 3 yr.?

1. If Alice deposits \$1 a week in a savings bank, beginning Jan. 1, how much will she deposit in $\frac{1}{2}$ yr. (26 wk.)? What is the smallest amount on deposit during this period?

2. The bank in Ex. 1 pays interest at 4% a year on the smallest balance on deposit during an interest period, adding the interest to the amount on deposit on Jan. 1 and July 1. On July 1 Alice will not get much interest. How much will she get? What will be the balance of her account?

3. If Alice keeps on depositing \$1 a week during the second half year, what is the balance of her account at the end of this 26 wk.? What is the smallest balance, disregarding the cents, during this period? How much interest is due? What is her balance after the interest is added to her account?

4. If Alice keeps up her deposits for another 6 mo., what will be her balance after the interest is added?

Copy the following table and fill the blank columns, taking the compound interest as payable every 6 mo. and disregarding the cents in the principal the same as a savings bank does:

	Original Principal	Number of Years	Rate of Interest	Simple Interest	Compound Interest	Difference
5.	\$2000	3	6%			
6.	\$4500	2	5%			
7.	\$6000	4	6%			
8.	\$8500	$3\frac{1}{2}$	4%			

9. At 6%, compounded every 6 mo., \$100,000 will amount to \$180,611.12 in 10 yr. A principal of \$1000 would amount to 0.01 as much. To how much would \$5000 amount?

YOUR post office is also a kind of savings bank. At it you can buy **postal savings stamps** for 10¢ each, which can be pasted on a card like the one here shown.

When the card is full, it will be accepted as a deposit of $1, and the post office will give you **a certificate of deposit** which bears simple interest at 2% a year.

Postal savings certificates may be exchanged for **postal savings bonds** which bear interest at $2\frac{1}{2}$%, payable every 6 mo.

Although the rate of interest is low and the interest is not compounded, some people prefer this method of saving. In a recent year the total deposits were about $146,360,000.

---

1. If Tom saves 10¢ a day for each of 200 working days, how many postal savings cards can he fill? If he exchanges the cards for certificates of deposit at $1 each, how much will he have on deposit at the end of this time?

2. In Ex. 1, how much will Tom get in interest each year? How much more would he get per year by exchanging his certificates of deposit for a postal savings bond?

At 2%, find the interest per year on a deposit of

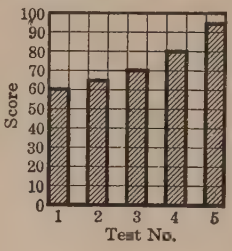
3. $40 **4.** $300 **5.** $500 **6.** $750 **7.** $2000

At $2\frac{1}{2}$%, find the interest per year on bonds to the amount of

8. $60 **9.** $120 **10.** $400 **11.** $800 **12.** $2000

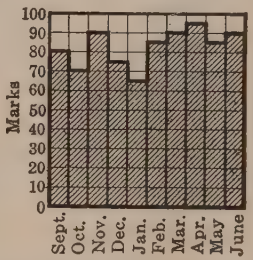
Bar Graphs

MOST of you probably know already how to keep a record of scores by means of a **graph.** This picture, for example, shows the scores that Mollie McGuire made on 5 arithmetic tests. Since the first bar stops at 60, her score on the first test was 60. The other scores in order were 65, 70, 80, and 95.



A graph like this, which uses bars to represent numbers, is called a **bar graph.**

1. This bar graph shows Helen Day's spelling marks last year. From the graph tell what her mark was for each month.



2. In which month did Helen have the highest mark? the lowest mark?

3. What was Helen's average mark for the 10 mo.? Which months were above the average? Which were below?

4. Last year the Stars won 5 baseball games, the Giants won 9, the Comets 6, the Tigers 11, and the Indians 8. Make a bar graph to show these facts, using 1 square to represent 1 game.

Draw bar graphs to show these facts:

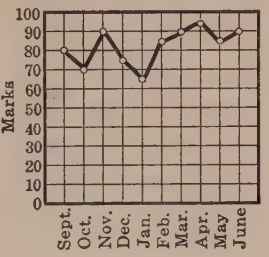
5. Distances jumped: Paul, 6 ft.; Joe, 7 ft.; Ida, 3 ft.; Dan, 5 ft.; Tom, 8 ft.; Roger, $7\frac{1}{2}$ ft.

6. Number of tickets sold for the school play: Lee, 25; Ned, 40; Hal, 10; Roger, 25; Arthur, 35.

7. Children's weights: Carl, 80 lb.; Mary, 65 lb.; Anne, 75 lb.; Jim, 90 lb.; Clara, 70 lb.; Fred, 85 lb.

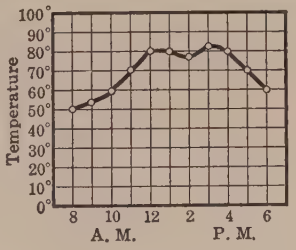
INSTEAD of using bars to represent Helen's spelling marks, as was done on the opposite page, a **line graph** like this one might have been used.

Since her September mark was 80%, a dot is first placed opposite 80 on the line for September, one opposite 70 for October, and so on for the rest of the year's marks. These dots are then joined by a series of short straight lines called a **broken line**.



1. Draw a broken-line graph to show these marks: Sept., 80%; Oct., 65%; Nov., 70%; Dec., 75%; Jan., 70%; Feb., 65%; Mar., 75%; April, 90%; May, 90%; June, 95%.

2. Instead of using a broken line, the points are sometimes joined by a **smooth curve**, as in this graph which shows how the temperature varied one summer's day. From the graph read the hourly temperatures, giving them to the nearest 1°.



3. In Ex. 2, when was the temperature the highest? the lowest?

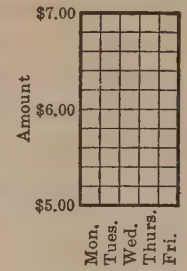
Draw curve-line graphs to show these facts:

4. Growth of a plant: 1st week, 3 in.; 2d, 4 in.; 3d, 6 in.; 4th, $5\frac{1}{2}$ in.; 5th, 3 in.

5. Boys' weights at different ages: 5 yr., 36 lb.; 6 yr., 38 lb.; 7 yr., 39 lb.; 8 yr., 41 lb.; 9 yr., 46 lb.; 10 yr., 48 lb.

6. Girls' weights at different heights: 40 in., 36 lb.; 41 in., 37 lb.; 42 in., 39 lb.; 43 in., 41 lb.; 44 in., 42 lb.; 45 in., 45 lb.

1. At the lunch room in the Adams School the receipts one week were as follows: Monday, \$5.20; Tuesday, \$6.60; Wednesday, \$5.30; Thursday, \$6.00; Friday, \$6.80. Using a piece of paper ruled and marked as here shown, draw a bar graph to represent these facts.



2. Represent the facts in Ex. 1 by means of a broken-line graph. Which kind of graph do you think tells the story more clearly?

3. To the nearest \$10, the weekly sales of a store for a period of 10 wk. were as follows: \$620, \$740, \$580, \$760, \$710, \$720, \$660, \$750, \$840, \$960. Draw a bar graph to show these facts. Does it look as though business was improving? Why do you think so?

4. In 10 wk. a boy saved the following amounts: 40¢, 50¢, 30¢, 20¢, 50¢, 15¢, 30¢, 0¢, 20¢, 10¢. Draw a bar graph to show these facts. Does it look as if the boy is learning how to save money? Give the reason for your answer.

5. Here is a table which shows how the average weights, in pounds, of boys and girls vary according to their ages:

Age	6	7	8	9	10	11	12	13	14	15	16	17	18
Boys	43	48	52	58	63	69	75	84	94	106	117	126	135
Girls	42	46	51	56	61	68	76	86	97	106	112	115	117

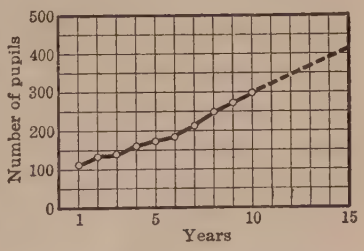
On the same sheet of paper, draw graphs to represent these facts, using a solid curve for the boys' weights and a dotted curve for the girls' weights. Between what ages do girls usually weigh more than boys of the same age? How do the graphs show this?

6. Here is a record of the daily temperature at noon in one week last spring: Monday, 64°; Tuesday, 68°; Wednesday, 75°; Thursday, 65°; Friday, 60°. Show this by a bar graph.

7. In Ex. 6, the hourly temperatures on Wednesday from 9 A.M. to 3 P.M. were as follows: 68°, 70°, 68°, 75°, 78°, 70°, 68°. Draw a curve-line graph to show these facts.

8. From the graph of Ex. 6, can you tell the temperature at 1:30 P.M. on Thursday? From the graph of Ex. 7, can you tell the approximate temperature at 1:30 P.M.? Why is a bar graph better for Ex. 6 and a curve-line graph for Ex. 7?

9. The solid line in this graph shows how the number of pupils of junior-high-school age in a small town has increased in the past 10 yr. Estimate as closely as you can the number of pupils that there were each year.



10. In Ex. 9, the dotted line shows the probable increase in the number of pupils for the next 5 yr. For approximately how many pupils will the school authorities have to plan in the 12th year? in the 15th year?

11. When James Lee went to work he had $100. During the next 10 yr. his yearly savings were as follows: $400, $400, $500, $500, $700, $800, $800, $1000, $1200, $1500. Draw a bar graph to show this, letting each square represent $100.

12. In Ex. 11, at the end of the first year James was worth $100 + $400, or $500. At the end of the second year, he was worth $500 + $400, or $900. Letting each square represent $100, draw a bar graph to show how his yearly savings increased his wealth, and compare it with the graph of Ex. 11.

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. John works in a store $1\frac{1}{2}$ hr. each school day and $5\frac{1}{2}$ hr. on Saturdays. At 40¢ an hour, how much does he earn per week?

2. In a class of 32 pupils, 20 were girls. What fractional part of the class were girls?

3. John bought a baseball glove, originally marked $3, at "$\frac{1}{4}$ off." How much did he have to pay for it?

4. From a field containing $6\frac{1}{2}$ A., Mr. Mott cut $16\frac{1}{4}$ T. of alfalfa. What was the average yield in tons per acre?

5. On a spelling test in which there were 50 words, Hal was marked 90%. How many words did he spell correctly?

6. The school nurse says that Louise is 10% under weight. Louise should weigh 70 lb. How much does she weigh?

7. In the Newville Junior High School 144 of the 450 pupils live on farms. What per cent of the pupils live on farms?

8. If 84% of the eggs in his incubator hatch, how many chicks will Mr. Mott get from the 500 eggs that he put in?

9. A salesman received a commission of $420 for selling a house for $12,000. What per cent did he charge?

10. Dan borrowed $90 at 6% and bought some young pigs. At the end of the year he sold them, paid his loan and the interest, and had $30 left. For how much did he sell the pigs?

CHAPTER TWO

USING PER CENTS IN BUSINESS

I. SHORT CUTS AND CHECKING

Saving Work and Time

THE successful business man does his work as easily as he can. By saving work he saves time, and in business saving time usually means saving money.

This work shows a short cut that can be used in multiplying and dividing by 25. Probably you already know it. Study the work carefully, remembering that 25 may be written $\frac{100}{4}$.

Example	Think	Answer
(1) 25×496	$49{,}600 \div 4$	12,400
(2) $7696 \div 25$	76.96×4	307.84

To multiply by 25, multiply by 100 and then divide by 4.
To divide by 25, divide by 100 and then multiply by 4.

Multiply each of these numbers by 25:

1. 397	3. 364	5. 101	7. 176	9. 16,648
2. 100	4. 484	6. 202	8. 400	10. 764,036

Divide each of these numbers by 25:

11. 675	12. 1575	13. 984	14. 1111	15. 401,700

Other Short Cuts

THERE are a number of other short cuts similar to the one given on the previous page. Here are a few that will show you how you can easily make up others as the need for them arises.

Study the work at the right in connection with the rules below.

Example	Think	Answer
(1) 125×246	$246{,}000 \div 8$	30,750
(2) $8462 \div 125$	8.462×8	67.696
(3) 9×457	$4570 - 457$	4113
(4) 11×369	$3690 + 369$	4059

learn

1. To multiply by 125, multiply by 1000 and divide by 8.

2. To divide by 125, divide by 1000 and multiply by 8.

3. To multiply by 9, multiply by 10 and then subtract the number multiplied.

4. To multiply by 11, multiply by 10 and then add the number multiplied.

---

1. What short method could you use in multiplying by 99? by 101? by 999? by 1001?

Give the short methods for multiplying and dividing that are suggested by the following relations:

2. $50 = \frac{100}{2}$ 3. $33\frac{1}{3} = \frac{100}{3}$ 4. $12\frac{1}{2} = \frac{100}{8}$

Using short methods, perform the following operations:

5. 9×168
6. 50×467
7. $33\frac{1}{3} \times 156$
8. $12\frac{1}{2} \times 256$
9. 125×382
10. $4826 \div 50$
11. 11×2857
12. $9682 \div 125$
13. 99×357
14. $825 \div 12\frac{1}{2}$
15. 101×2426
16. $568.9 \div 33\frac{1}{3}$
17. $16\frac{2}{3} \times 696$
18. $66\frac{2}{3} \times 1272$
19. $1482 \div 16\frac{2}{3}$

1. Officer Brennan averages 125 mi. a day on his motorcycle. At this rate, how many miles does he cover in 24 da.? Which is easier for you, — to think of 24×125 or of $24{,}000 \div 8$?

2. If the officer travels at an average speed of 25 mi. per hour, how long will it take him to go 168 mi.? Which is easier for you, — to think of $168 \div 25$ or of 1.68×4?

3. At an average speed of $33\frac{1}{3}$ mi. per hour, how far could a motorcycle officer travel in 12 hr.?

4. At \$1.80 per bushel, how much will a farmer get for 25 bu. of wheat? for 125 bu.?

5. At an average of 125 mi. per day, how many days will it take for an automobile trip of 2500 mi.?

6. A company secured a 99-year lease of a piece of land at a yearly rental of \$4675. If the agreement is kept for the whole period, what will be the total amount of rent paid?

See how quickly you can do these examples:

7. $72 \times 12\frac{1}{2}$	11. $360 \times 16\frac{2}{3}$	15. $25 \times \$164$
8. $75 \div 12\frac{1}{2}$	12. $900 \div 16\frac{2}{3}$	16. $\$16{,}500 \div 25$
9. $81 \times 33\frac{1}{3}$	13. 50×4864	17. $100 \div 33\frac{1}{3}$
10. $81 \div 33\frac{1}{3}$	14. $11{,}335 \div 50$	18. $700 \div 33\frac{1}{3}$

WHY does Mary Reynolds always have good marks in arithmetic? One reason is that **she always remembers to check her work.** She knows that there is no fun in working hard and then having a number of answers wrong.

Check your additions by adding in the opposite direction.

That is, if you have added up, check by adding down; if you have added down, check by adding up.

Check your subtractions by adding the difference (the answer) to the number subtracted (the subtrahend), adding upward. The sum should be the top number (the minuend).

This is so easy that there is no excuse for not checking.

Check your multiplications and divisions by going over your work carefully a second time.

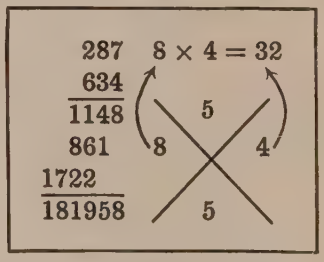
The following check on division, although somewhat long, may also be used if you wish:

Dividend = divisor × quotient + remainder.

This work shows how the **check of 9's** is used in checking the product of 634×287. In 287 the sum of 2, 8, and 7 is 17, and $17 = 9 + 8$. Drop the 9, and write 8 in the left angle of the cross.

In 634 the sum is 13, or $9 + 4$. Write 4 in the opposite angle.

Now $8 \times 4 = 32$ and $3 + 2 = 5$. Write 5 at the top of the cross.



In 181,958 the sum is 32, or $27 + 5$. Drop the three 9's (27), and write 5 at the bottom. If the top and bottom numbers are the same, as in this case, you can be fairly sure that the answer is right because the check rarely fails.

THERE are a number of mistakes on this page. See if you can find them all. When you find an incorrect answer, give the correct one, numbering it with the example number.

Check these additions and subtractions:

1.	2.	3.	4.	5.
904	898	640	106	$4.29
775	789	368	739	5.65
+ 878	+ 669	+ 608	+ 242	+ 3.89
2558	2256	1616	1087	$23.83

6.	7.	8.	9.	10.
970	346	841	703	$16.21
− 115	− 167	− 61	− 697	− 5.23
755	279	780	106	$10.98

Check these multiplications by going over the work, or, if your teacher says to, by using the check of 9's:

11.	12.	13.
249	375	408
34	28	760
996	3000	24480
747	750	3356
8466	10500	360080

Check these divisions by going over the work:

14.	15.	16.
622	$825\frac{1}{14}$	487
27)16794	56)45204	38)18206
162	448	152
59	140	300
54	112	274
54	284	266
54	280	266
	4	

IN SOLVING problems you can often save yourself from making absurd mistakes by **estimating the answer before you begin.** This is only a rough check, but it is a good one.

Compare your answer with your estimate; if they differ very much, go over your work again.

In each case first tell which of the four estimates in the parentheses you think is best, and then solve the problem:

1. Mr. Graves earns $5.40 per day. How much does he earn in 6 da.? ($32, $18, $45, $0.90)

2. At an average of 24 mi. per hour, how far will a freight train go in $2\frac{1}{2}$ hr.? ($26\frac{1}{2}$ mi., 120 mi., 55 mi., $2\frac{1}{2}$ mi.)

3. At 20% off, how much will you have to pay for an automobile tire which regularly sells for $12.50? ($15, $22.50, $2.50, $10)

4. From a 28-acre field a farmer got 3920 bu. of potatoes. What was the average yield in bushels per acre? (135 bu., 28 bu., 50 bu., 948 bu.)

5. Mary West earns $30 a week in a department store. If she saves $2.80 a week, what per cent of her income is she devoting to savings? (28%, 30%, 9%, 15%)

6. Mrs. Ray spent $1.56 for groceries on Monday, $2.40 on Tuesday, $0.85 on Wednesday, $1.75 on Thursday, $2.15 on Friday, and $1.48 on Saturday. How much did she spend for groceries that week? ($44, $10, $5.50, $22)

7. When Ann makes a visit to her grandmother, she has to spend $6\frac{1}{2}$ hr. on the train. If she takes a train that leaves at 8:20 A.M., at what time is she due to arrive? (3 P.M., 8:50 P.M., 3 A.M., 6:30 P.M.)

Before solving each of these problems, estimate the answer:

1. This morning when he started out, the mileage dial on Mr. Clark's car registered 8979 mi. It now registers 9147 mi. How far has he driven his car since morning?

2. At 21¢ a gallon, how much will it cost for gasoline on a trip that requires $14\frac{1}{2}$ gal.?

3. While touring the mountains, the Jones family one day drove 18 mi. the first hour, 26 mi. the second, and 28 mi. the third. What was the average speed for the 3 hr.?

4. When Mr. West bought a new car, he turned in his old one which had cost $1150. He was allowed 40% of this price toward the new car. To how much did this allowance amount?

5. Mr. Greene bought a car that cost $885, paying $300 down and the balance in monthly installments of $65 each. How many of these monthly payments did he have to make?

Tell how you would solve each of these problems if the numbers that belong in the blank spaces were given:

1. Mary has $——. At ——¢ a quart, how many quarts of ice cream can she buy for her party?

2. The West family's yearly income is $——. In her budget, Mrs. West allows ——% of this for rent. How much does she allow for this purpose per year?

3. From some money which Mr. Cole invested at ——%, he gets an income of $—— per year. How much money did he put into this investment?

4. At the William King School the school day is divided into —— periods of —— min. each. How long is the school day?

5. Water weighs —— lb. per cubic foot. What weight of water can be put into a tank that holds —— cu. ft.?

6. Wheat weighs —— lb. per bushel. A farmer hauled a load of wheat that weighed —— lb. to the elevator. How many bushels were there in the load?

7. When he borrowed $—— in order to buy a house, Mr. Hart had to pay $—— a year in interest. At what rate of interest did he borrow the money?

8. At a sale at which ——% off is given, how much will Mrs. Davis pay for a dress that regularly sells for $——?

9. When he borrowed $—— at the bank in order to buy goods for the fall trade, Mr. Whitehouse had to pay interest at ——%. If he pays the loan in —— mo., how much interest will he have to pay?

10. When Mr. Hale sold his house, which cost him $——, he made a profit of ——% of what he paid for it. How much profit did he make? For how much did he sell the house?

SOMETIMES in actual life you **know more facts** about a situation than are needed in order to solve some problem about it. In such cases, simply pick out what is needed in order to solve the problem and pay no attention to the rest.

Sometimes you **do not know enough facts.** In such cases the problem cannot be solved.

Solve as many of these problems as you can, selecting only the necessary facts, and tell why the others cannot be solved:

1. Mr. West is 41 yr. old. He earns $350 a month. How much does he earn per year?

2. When Mrs. West went shopping, she had $8.50 in her purse. She bought $4\frac{1}{2}$ lb. of beef at 52¢ a pound and gave the clerk a 5-dollar bill. How much change did she get?

3. Mrs. Roberts paid $14.40 for some silk, which was twice as much per yard as she paid for some last year. How much did the silk that she bought last year cost per yard?

4. Fred's watch gains $1\frac{1}{2}$ min. per day. He gained $10\frac{1}{2}$ lb. last year. In how many days will the watch gain 1 hr.?

5. Mr. Gray bought a house that cost $8500, paying $3000 down and the rest in yearly installments. What was the amount of each yearly payment?

6. Last week Mr. Holt drove his car 480 mi. He paid 21¢ a gallon for gasoline and $16.75 for repairing a broken spring. If he averaged 20 mi. per gallon of gasoline, how much did it cost him for gasoline for the week?

7. Mrs. Stone allows 26% of the family income for the running expenses of the house and 30% for food. How much money does she allow for each of these purposes per month?

Review Practice

IN THE work on this page see how quickly you can get the answers to all the different examples, but remember that accuracy in arithmetic is always more important than speed.

Multiply:

1. $8 \times 2\frac{3}{4}$
2. $4\frac{7}{8} \times 16$
3. $2\frac{1}{2} \times \frac{3}{4}$
4. $4\frac{5}{8} \times 1\frac{1}{2}$
5. $3\frac{2}{3} \times \frac{1}{2}$
6. $4\frac{2}{3} \times 3\frac{1}{4}$

Divide:

7. $\frac{3}{4}$ by $\frac{1}{2}$
8. $\frac{2}{3}$ by $\frac{1}{3}$
9. $4\frac{5}{8}$ by $\frac{1}{8}$
10. $5\frac{1}{4}$ by $\frac{3}{4}$
11. $8\frac{7}{8}$ by $1\frac{1}{4}$
12. $3\frac{3}{5}$ by 9
13. 25 by $2\frac{1}{2}$
14. 50 by $16\frac{2}{3}$

Do these common types of addition examples:

15.	16.	17.	18.	19.
2.7	4.0	17.68	16.83	1.680
3.8	7.6	.47	1.96	.043
.6	8.4	2.39	.59	2.000

Do these common types of subtraction examples:

20.	21.	22.	23.	24.
5.23	7.01	92.0	1.473	43.00
1.48	.57	7.6	.628	1.96

Here are some unusual examples in addition and subtraction. If your teacher tells you to, see if you can do them:

25.	26.	27.	28.	29.
4.26	5.1	1.24	0.891	870
5.	$.27\frac{1}{3}$	3.068	2.1	6.28
$+ 1.3\frac{1}{3}$	$+ 4\frac{1}{5}$	$+ 5.7$	$+ .64$	$+ 11$

30.	31.	32.	33.	34.
$4\frac{5}{11}$	$8.13\frac{1}{2}$	52	3.182	24.3
$- 2\frac{1}{5}$	$- 4.6\frac{1}{4}$	$- 3.5$	$- .09$	$- 1.69$

More about Commission

THE first part of the year you learned how people earn money by selling on commission instead of receiving a regular salary or wages. You found that

Amount of commission = per cent × amount of sale.

For example, if Mr. Ware is paid a commission of 5% on a sale that amounts to \$3000, the amount of commission that he earns from this sale is, as here shown, \$150.00, or simply \$150.

\$3000 ← Amount of sale
× 0.05 ← Rate of commission
\$150.00 ← Amount of commission

There is another problem connected with this sale; namely, that of finding how much the company for which he works receives from the sale. As here shown, the amount is \$2850.

\$3000 ← Amount of sale
− 150 ← Amount of commission
\$2850 ← Proceeds

The amount left after deducting (subtracting) the commission is called the **proceeds** of the sale.

Proceeds = amount of sale − amount of commission.

1. If you know the amount of a sale and the rate of commission paid, how do you find the amount of commission earned?

2. If you know the amount of a sale and the rate of commission paid, how do you find the proceeds of the sale?

3. Make up and solve an easy problem about commission to illustrate your answer to Ex. 2.

Problems about Commission

1. An automobile agency pays its salesmen a commission of 5% on the amount of each sale. How much commission does a salesman earn in selling a car for $1450?

2. In Ex. 1, what are the proceeds that the agency receives from the sale of the car?

3. Mr. Bond is a salesman for a company that manufactures vacuum cleaners. He receives a commission of 15% on the amount of his sales. Last month he sold 46 machines at $42.50 each. How much commission did he earn? What were the proceeds received by the company?

4. In Ex. 3, Mr. Bond has to pay his own expenses. Last month they amounted to $87.56. How much income did he have left after deducting his expenses?

5. Ted's older brother is helping to pay his way through college by getting subscriptions to magazines. One month he got 21 subscriptions at $2 each, 14 at $3.50 each, and 16 at $4 each. He received a commission of 12% on the total. How much did he earn? What were the proceeds that he sent to the publishers of the magazines?

6. Mr. Bartlett is thinking of buying a new car. One dealer offers $250 for his old car if he will turn it in toward the new one. A secondhand dealer offers to sell the old car for $300. His commission will be 12%. Which is the better offer for Mr. Bartlett to take, and how much better is it?

7. Commissions are often paid to people who buy things instead of selling them. Jack's father drives through the country in his car and buys apples for a dealer in the city. He is paid a commission of $4\frac{1}{2}$% on the total of his purchases. Last week he bought $9650 worth of apples. How much commission did he earn that week?

1. Mary Watts works in the jewelry department of the Atlas Department Store. In addition to her weekly salary of $16, she is paid a commission of 2% on the total of her weekly sales **above $500, any cents in the total being disregarded.** Last week she sold $985.40 worth of goods. How much commission did she earn? How much did she earn in all that week?

As in Ex. 1, find the commission and the total earnings for these girls who worked in the same department with Mary:

	Name	Weekly Salary	Total Sales	Commission Earned	Total Earnings
2.	Kate Greene . .	$14.50	$678.50		
3.	Mabel Ware . .	$16.50	$972.24		
4.	Susie Hall . . .	$15.00	$813.08		
5.	Hazel Lewis . .	$17.50	$506.94		
6.	Anne Barton . .	$15.75	$625.16		

Commissions and Farming

FARMERS who raise vegetables and other things in large quantities do not usually sell them directly to people in the cities. Instead, a farmer usually ships his produce to some **commission merchant** in the city who sells it for him and charges the farmer a commission for making the sale.

1. A commission merchant sold $640 worth of cabbages for a farmer. At 8%, how much commission did the farmer pay? How much did the farmer receive as the proceeds of the sale?

2. Mr. Hill ships his apples to Rowe & Frost, commission merchants in the city. They charge a commission of 10%. On one lot that was sold for $782.75, the freight, which was charged to Mr. Hill, amounted to $116.30. How much commission did Mr. Hill pay? How much did Rowe & Frost pay Mr. Hill after deducting the freight charges and their commission?

3. A commission merchant sold 22,120 lb. of potatoes for a farmer at $3\frac{1}{2}$¢ a pound, and charged a commission of 10%. The **transportation charges** (freight or express) amounted to $87.65. What were the **net proceeds** (the proceeds after all charges are paid) received by the farmer from this sale?

Find the numbers that belong in the blank columns:

	Amount of Sale	Rate of Commission	Transportation Charges	Amount of Commission	Net Proceeds
4.	$182.50	8%	$16.20		
5.	$448.75	12%	$96.40		
6.	$672.90	10%	$108.65		
7.	$1140.80	$12\frac{1}{2}$%	$193.38		

1. Mr. Howe is a salesman for the Suburban Land Co., which is building a number of new houses on the property known as "Sunshine Acres." He receives a commission of $3\frac{1}{2}\%$ on his sales. How much does he earn when he sells a house for \$8500? How much are the company's proceeds?

2. One month Mr. Howe sold one house for \$9800, another for \$10,400, a third for \$15,000, and a fourth for \$11,500. How much commission did he earn in all that month?

3. Land and houses are called **real estate**, and a man who makes a business of buying and selling real estate is called a **realtor**. At $2\frac{1}{2}\%$, how much commission does a realtor earn in selling a piece of property for \$42,500?

4. Mr. Whitney sold Mr. Ray's house for \$9800 and charged him a commission of 4%. How much did Mr. Ray receive as the proceeds of the sale?

5. In Ex. 4, Mr. Whitney's expenses in making the sale amounted to \$48.60. How much did he have left from his commission after deducting the expenses?

Other Problems in Commission

1. When he sold Mrs. Morton's house for $30,000, Mr. Joyce earned a commission of $900. What rate of commission did he charge? Of what two numbers is the amount of commission always the product? In this case, what is the given product? What is the given factor? How can you find the missing factor? What is it?

Find the rate of commission when the amount of the sale and the amount of commission earned are as follows:

2. $250, $10
3. $864, $25.92
4. $1500, $75
5. $2800, $140
6. $16,000, $560
7. $24,500, $1347.50

8. A commission merchant who charges 8% earned a commission of $20.32 in selling some vegetables. For how much were the vegetables sold? In this case, what is the given product? What is the given factor? How can you find the missing factor? What is it?

Find the amount of the sale when the amount of commission earned and the rate charged are as follows:

9. $160, 10%
10. $250, 5%
11. $72, 8%
12. $480, 12%
13. $19.92, 2%
14. $402.50, $3\frac{1}{2}$%

Find the numbers that belong in the blank spaces below:

	Amount of Sale	Rate of Commission	Amount of Commission
15.	$3600	$2\frac{3}{4}$%	$\_\_\_\_$
16.	$2750	___%	$44.00
17.	$\_\_\_\_\_$	8%	$67.20
18.	$16,500	___%	$742.50
19.	$26,800	$3\frac{3}{4}$%	$\_\_\_\_$

1. The White Collection Agency charges a commission of $8\frac{1}{2}\%$ for collecting overdue bills. On a bill amounting to \$142.80, how much commission does the agency charge?

2. A commission merchant sold a carload of eggs at 40¢ per dozen and charged a commission of 1¢ per dozen. What rate of commission was he charging?

3. A commission merchant sold some vegetables for a farmer. After deducting \$65.40 for commission and \$83.46 for transportation charges, he sent the farmer a check for \$668.64 as the net proceeds of the sale. What was the amount of the sale? What rate of commission did the merchant charge?

4. A traveling salesman works on a "sliding scale" of commissions, the rate increasing as his sales increase. On the first \$25,000 worth of business he receives 6%, on the next \$25,000 he receives $6\frac{1}{2}\%$, and on all business over \$50,000 he receives 7%. Last year he sold \$63,280 worth of goods. How much did he earn in commissions that year?

SPECIAL TIMED PRACTICE

Time: 5 min.

1. \$62.84	2. 824.3	3. 6.237	4. \$86.25	5. 72.80
18.75	19.5	8.450	19.50	13.00
+ 9.30	207.0	.285	8.40	+ 9.07
	+ 50.8	6.875	+ 66.82	
		+ .985		
6. \$18.54	7. 801.0	8. \$52.87	9. 180.17	10. $9.8\overline{)2.842}$
− 9.87	− 482.7	× 144	× 3.08	

Problem Solving

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. A farmer sold three chickens that weighed 3 lb. 4 oz., 2 lb. 12 oz., and 3 lb. 2 oz. How many pounds of chicken did he sell?

2. In an addition example, John got $21\frac{1}{4}$ as the sum of two numbers. One number was $16\frac{1}{2}$. What was the other?

3. Mr. Barr earned \$33 in $5\frac{1}{2}$ da. last week. How much will he earn in a week in which he works only $3\frac{1}{2}$ da.?

4. At an average speed of 33.5 mi. per hour, how far will a train go in 2.6 hr.?

5. A real-estate salesman sold a house for \$12,450. At $3\frac{3}{4}\%$, how much commission did he earn?

6. At a sale Mrs. Case bought a radio, originally marked \$85, at 20% off. How much did she pay for it?

7. When 95% of the 640 pupils in a school are present, how many are absent?

8. If a piano that regularly sells for \$400 can be bought for \$340, at what per cent off can it be bought?

9. If Mr. Kerr borrows \$1600 from his bank for 6 mo. at 6%, how much interest will he have to pay?

10. In a reading test, Edna Gray read 240 words per minute, while Mary Waters could read only $\frac{7}{8}$ as many. How many words per minute did Mary read?

The Merchant's Discounts

YOU have already seen how people can sometimes save money by buying at bargain sales where discounts are given. Merchants, or **retail dealers** as they are called, are often allowed discounts by the **wholesale dealers or manufacturers** from whom they buy the goods to sell in their stores.

In the wholesale business the bill sent with a shipment of goods is called an **invoice**. Here is a simple form of invoice:

WHITEHOUSE AND MEAD
Makers of Fine Furniture
CHICAGO, ILL.

T. R. Hunt & Co.
1627 East Ave.
St. Louis, Mo.

Date May 9, 19—
Order No. 67285
Terms 2%, 10 da.

Quantity	Stock No.	Item	Price	Extension	Total
6	608N	Bureaus	42.50	255.00	
18	490X	Bedsteads	26.75	481.50	
12	155K	Dressing Tables	36.00	432.00	
				1168.50	
		Discount, 33⅓%		389.50	
					779.00

In this case a discount of $33\frac{1}{3}\%$ is allowed by the manufacturer. Such a discount is called a **trade discount**. The prices in the column headed "Price" are those listed in the manufacturer's catalogue. Such prices are called **list prices**.

The amount of an invoice after the trade discount is taken off is called the **net amount**. The expression "Terms, 2%, 10 da." on the invoice means that Hunt & Co. may take off **an additional 2% of the net amount** if they pay for the goods within 10 da. Such a discount is called a **cash discount**.

Problems about Invoices

IN THE invoice on page 85, the column headed "Extension" shows the total cost, at list prices, for each item in the shipment. Filling in this column is called **making the extensions.**

In the work below, you can use the form of invoice shown on page 85, unless you know of some other that you prefer.

Write an invoice for each of the following wholesale orders for goods, make the extensions, and show the net amount after taking off the trade discount:

1. 12 dining tables @ $64.50; 60 dining chairs @ $9.75; 15 dressing tables @ $34.50; 12 bureaus @ $38.75; 6 arm-chairs @ $16.50. Trade discount, 40%.

2. 240 yd. taffeta @ $2.75; 140 yd. velvet @ $3.65; 160 yd. satin @ $2.60; 120 yd. crêpe @ $2.90; 275 yd. linen @ $1.85; 350 yd. cretonne @ 65¢. Trade discount, 35%.

3. 12 automobile cushions @ $2.50; 24 tire gauges @ $1.10; 36 sets tire chains @ $5.50; 18 rear-vision mirrors @ $4.50; 6 luggage carriers @ $2.75; 8 spare-tire covers @ $2.75; 6 dashboard clocks @ $12.50. Trade discount, 45%.

4. 6 doz. heavy coat sweaters @ $54.60 (which means $54.60 per dozen); 8 doz. slip-on sweaters @ $44.75; 2 doz. knitted caps @ $27.25; 5 doz. mufflers @ $42.50; 12 doz. golf hose @ $28.60; 18 doz. tennis socks @ $11.40. Trade discount, 35%.

5. 120 bags flour @ $1.15; 675 lb. granulated sugar @ $6\frac{1}{4}$¢; 120 lb. powdered sugar @ $8\frac{1}{2}$¢; 40 cases string beans @ $5.45; 36 cases corn @ $3.15; 18 cases asparagus @ $6.75; 24 cases baked beans @ $5.25; 60 cases tomatoes @ $3.85; 30 cases canned milk @ $1.90; 48 cases lima beans @ $6.40; 18 cases assorted soups @ $1.75. Trade discount, 30%.

Courtesy of the Paine Furniture Co.

THE merchant must know exactly how much his goods cost him. On a shipment of desks bought by the Fox Furniture Co. the invoice showed that the list price of each desk was \$68. If the trade discount was 35%, what was the net price?

You can, of course, answer this by finding 35% of \$68 and subtracting.

A shorter way is to find in one step the number that is **35% less than** \$68.

If from \$68 you take 35% of itself, what per cent of \$68 is left?

How much is 65% of \$68? How do you find it? What did each desk cost?

\$68
0.65
3 40
40 8
\$44.20

To find the net price, subtract the rate of discount from 1.00, and multiply the list price by the result.

Whenever it is easier, as in 25% or $12\frac{1}{2}$%, use fractions.

Discounts from List Prices

1. The Fox Furniture Co. ordered some tables listed at $64 each, less a trade discount of 40%. What was the net price of each table? Which is easier for you, to think of $0.60 \times \$64$ or of $\frac{3}{5}$ of $64? Try both ways.

2. A dealer bought some stoves listed at $87 each, less a discount of $33\frac{1}{3}\%$. What was the net price of each stove?

3. A manufacturer lists a certain style of chair at $32, less a trade discount of 35%. To find the net price that a dealer has to pay for it, you have to find the number that is 35% less than what other number? What is the net price?

In each of the following cases find the number that is the specified per cent less than the given number:

4. $50, 10%	8. $150, 20%	12. $2.50, 40%
5. $60, 25%	9. $500, 50%	13. $3.60, $33\frac{1}{3}\%$
6. $70, 30%	10. $800, 30%	14. $9.90, $66\frac{2}{3}\%$
7. $90, 40%	11. $450, $66\frac{2}{3}\%$	15. $18.40, $12\frac{1}{2}\%$

16. On a plane listed at $3 a hardware dealer received a discount of $1.20. To find what rate of discount he received, you have to find what per cent $1.20 is of what number? How do you find what per cent one number is of another? What per cent of discount did the dealer receive?

17. On a vise listed at $6.90 the net price was $4.60. What was the amount of the discount? What was the rate?

In each of the following cases find the rate of discount when the list price and the net price are as follows:

18. $6, $3.60	20. $42, $28	22. $85, $59.50
19. $12, $7.80	21. $24, $18.24	23. $130, $84.50

HERE is another problem about discounts. It is almost the opposite of the problem on page 87, and so it should be easy to see how to solve it.

On a shipment of desks the Fox Furniture Co. was allowed a trade discount of 35%. If the net price of each desk was $44.20, at what price were they listed by the manufacturer?

Here you know that $44.20 is **35% less than the list price.** In other words, it is **65% of the list price**; that is,

$$\$44.20 = 0.65 \times \text{list price}.$$

Which is the given product? Which is the given factor? How do you find the missing factor in such a case?

The list price is $68.

$$\begin{array}{r} \$68. \\ \hline \emptyset.65\wedge)\$44.20\wedge \\ 39\ 0 \\ \hline 5\ 20 \\ 5\ 20 \\ \hline \end{array}$$

You will not often have to solve problems like this, but with what you know about discounts they are not hard.

---

1. A dealer who was allowed a trade discount of 40% paid $7.20 apiece for some chairs. By what do you divide $7.20 to get the list price? What was the list price?

2. On a bedroom set for which he paid $100 a dealer was allowed a discount of $33\frac{1}{3}$%. What was the list price? By what do you divide? What is the easy way to do it?

In each of the following cases find the list price when the net price to the dealer and the rate of discount are as follows:

3. $13, 35%
4. $9.75, 35%
5. $17.50, 30%
6. $27, 25%
7. $60, $33\frac{1}{3}$%
8. $56, $12\frac{1}{2}$%
9. $71.50, 35%
10. $62.70, 40%
11. $94.72, 26%

1. As already explained, in the invoice on page 85 Hunt & Co. are allowed an extra discount of 2% of the net amount if the account is settled in 10 da. from May 9. To how much will this cash discount amount?

2. A dealer placed an order for dress goods amounting to $1528.50 at list prices. If he was allowed a trade discount of $33\frac{1}{3}\%$, what was the net amount of the order?

3. In Ex. 2, the terms under which the goods were sold were 3%, 10 da. If the dealer takes this cash discount, how much will he have to pay to settle the account?

4. Mr. Hoyt always "discounts his bills"; that is, he pays them in time to get the cash discounts. One month he saved $864.20 by taking cash discounts of 2% on his invoices. What was the total net amount of these invoices?

5. A dealer who is allowed a trade discount of 30% orders goods amounting to $1280 at list prices. What is the net amount of the order? The terms are 5/10, 2/30, net 60, which means a cash discount of 5% if paid within 10 da., one of 2% if paid between the 10th and 30th days, and the net amount to be paid within 60 da. How much will the dealer pay to settle the account on the 9th day? the 16th day? the 50th day?

6. A dealer saved $10.38 by taking a cash discount of 2% on one of his invoices from which a trade discount of 40% had already been deducted. What was the net amount of the invoice? To how much did the order amount at list prices?

7. One factory sells a certain kind of table at a list price of $72, less a trade discount of $33\frac{1}{3}\%$. What trade discount should be offered by a second factory which lists a similar table at $80 in order that the net prices should be the same?

IN SOME kinds of business, two or more trade discounts are sometimes allowed on the same invoice. For example, a dealer who allows discounts of 15% and 10% from his list prices is said to be giving a chain discount of 15%, 10%.

The two discounts may be deducted, one after the other, as here shown.

$1750.00	← Total at list prices
− 262.50	← 15% of $1750.00
$1487.50	
− 148.75	← 10% of $1487.50
$1338.75	← Net amount

1. In the example above, show that the net amount is the same if you take off the 10% first and then the 15%.

2. Since 100% − 15% = 85% and 100% − 10% = 90%, the net amount in the example above could be found by taking 90% of 85% of $1750, or $0.90 \times 0.85 \times \$1750$. How much is 0.90×0.85? Multiply $1750 by this result.

3. A dealer bought goods amounting to $2350 at list prices, less a discount of 20%, 10%. Find the net amount of the invoice, (1) as at the top of the page, and (2) as in Ex. 2.

4. In Ex. 3 you found the net amount by multiplying $2350 by 0.90×0.80. How much is 0.90×0.80? Subtract the result from 1.00. To what single discount is 20%, 10% equal?

Find the net amount in each of the following cases:

5. $400; 15%, 10% off
6. $850; 20%, 10% off
7. $1500; 18%, 10% off
8. $1850; 20%, 10% off
9. $3000; 12%, 8% off
10. $1250; 5%, 5% off
11. $1650; 15%, 10% off
12. $2760; $16\frac{2}{3}$%, 10% off

1. A school ordered 24 doz. rulers at $1.10 per dozen, less 25%. What was the net amount of the bill?

2. The Ajax Hardware Store bought 1200 ft. of clothesline at a list price of $1\frac{3}{4}¢$ a foot. If a discount of 25%, 10% was allowed, what was the net amount of the bill?

3. A dealer ordered goods amounting to $842.50 at list prices, with a trade discount of 40%. If he is allowed an additional 2% for cash, how much will he save by paying the bill before the cash discount expires?

4. On an article listed at $100 one wholesaler offers a trade discount of 40%, and another offers a discount of 20%, 20%. If you were doing the buying for the retail dealer, which offer would you accept?

Find the amount of each of these discounts:

5. 35% on $250.00
6. 40% on $50.50
7. 30% on $425.75
8. 25% on $380.40
9. 40% on $650.20
10. 35% on $875.18
11. 30% on $1215.00
12. $37\frac{1}{2}$% on $1460.32
13. 40% on $1585.60
14. 28% on $1625.40
15. 15%, 10% on $1840.00
16. 20%, 15% on $1628.50

Find the missing numbers:

17. $7 is ——% of $28
18. $—— is 2% of $62
19. $9 is 6% of $——
20. $8 is ——% of $64
21. $21 is 35% of $——
22. $28 is ——% of $70
23. $90 is 45% of $——
24. $—— is 40% of $84

Running a Store

IT COSTS considerable money to run an up-to-date store. Besides the cost of the goods, there are many expenses such as rent, heat, light, advertising, salaries of clerks, and the like. Such expenses are frequently referred to as overhead expenses, or simply as overhead.

One of the great problems of the merchant is to keep overhead as low as possible and still run a first-class store.

If he is to stay in business and make money for himself, the merchant must sell his goods so that he will get enough from them to cover the cost and the overhead and leave a profit.

The dealer who sells for $1.50 an article for which he pays $1 is not making a profit of 50¢. Out of the 50¢ must come some allowance for overhead.

Per Cents More

DEALERS usually plan to sell their goods for a certain per cent more than the cost. **This per cent must be large enough to cover overhead expenses and allow a profit.**

For example, a furniture dealer decides to sell a set of furniture for which he paid $125 at 40% more than it cost him. At what price should he plan to sell the set?

How much is 40% of $125? For how much more than $125 should the dealer sell the set? At what price should he sell it? What two operations did you have to use in order to find the answer this way?

$125
1.40
50 00
125
$175.00

There is a shorter way to solve this problem, as shown in the work above. If you add 40% of a number to the number itself, what per cent of the number do you have? How much is 140% of $125? How do you find it?

---

1. When the National Market has to pay 20¢ per pound for lamb, for how much per pound should they sell it in order to get 40% more than the cost?

2. A dealer paid $1.50 per can for sirup in gallon cans. If he wishes to sell the sirup at 30% more than it cost, at what price per can should he sell it?

In each of the following cases find the number that is the specified per cent more than the given number:

3. $16, 25%
4. $25, 25%
5. $24, $33\frac{1}{3}$%
6. $32, $37\frac{1}{2}$%
7. $125, 6%
8. $200, 10%
9. $4.25, 20%
10. $14.50, 40%
11. $3, 50%
12. $50, 3%
13. $50, 100%
14. $50, 150%

HERE is a problem which is almost the opposite of the one on page 94: A dealer sold a set of furniture for $175, which was 40% more than he paid for it. How much did the set cost him?

Here you know that the price of $175 is **40% more than the cost.** It is therefore **140% of the cost**; that is,

$$\$175 = 1.40 \times \text{cost}.$$

How can you find the missing factor in this case? What is it?

As shown, the answer is $125.

$$\begin{array}{r} \$12\ 5. \\ 1.4\text{Ø})\overline{\$175.0\text{Ø}} \\ 14 \\ \hline 35 \\ 28 \\ \hline 70 \\ 70 \\ \hline \end{array}$$

Another great problem of the merchant is to determine at what per cent more than the cost he should sell his goods.

---

1. The National Market is selling lamb at 28¢ a pound, which is 40% more than it cost. By what do you divide to find how much the lamb cost per pound? What was this cost?

2. \$150 is $33\frac{1}{3}$% more than what number? Instead of dividing by $1.33\frac{1}{3}$, what fraction would be easier to use?

Find the numbers that belong in the blank spaces:

	This Amount	Is This Per Cent	More Than
3.	$11	10%	$____
4.	$24	50%	$____
5.	$75	___%	$50
6.	$____	40%	$40
7.	$180	$33\frac{1}{3}$%	$____

	This Amount	Is This Per Cent	More Than
8.	$468	30%	$____
9.	$450	___%	$360
10.	$____	45%	$650
11.	$22.00	___%	$16.50
12.	$31.50	40%	$____

Margin and Overhead

THE merchant learns by experience for how much more than the cost he should sell his goods. The difference between cost and selling price is often called **margin.**

Selling price = cost + margin.

Out of the merchant's margins on his year's sales must come his overhead expenses and whatever profit he makes.

Selling price = cost + overhead + profit.

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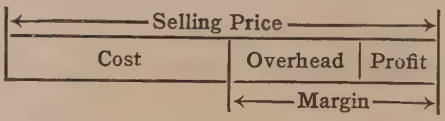
1. Study this diagram, which expresses in another way the relation of selling price, cost, overhead, and profit. Of what is the selling price made up?



2. Mrs. Reed paid 32¢ a pound for a roast of lamb at the National Market. The market paid the wholesale dealer 24¢ a pound. How much was the market's margin per pound?

3. On the sale in Ex. 2, the market made a profit of 1.6¢ a pound. How much per pound was the allowance for overhead?

4. The term **gross profit** is sometimes used in place of "margin." How much gross profit does a dealer make when he sells for $14.50 an article which costs $9.75?

5. Overhead is often estimated as a certain per cent of the selling price of an article. In a store that allows 35% of the selling price for overhead, to how much does the overhead amount on an article that sells for $5? for $12? for $7.50?

6. In a store in which the total sales last year amounted to $65,000, the overhead amounted to $18,200. The overhead was what per cent of the sales?

IN DETERMINING the selling price of an article, the merchant usually estimates the profit that he wishes to make as a per cent. There are two ways in common use for expressing this per cent, — (1) **as a per cent of the cost**, and (2) **as a per cent of the selling price.**

To take a simple case, suppose that a dealer sells for \$15 a lamp which cost him \$10. If the allowance for overhead on this article is \$3.50, the per cent of profit that he makes can be expressed in either one of the two ways shown below:

\$10.00 ← Cost	\$15.00 ← Selling price
+ 3.50 ← Overhead	− 13.50 ← Cost + overhead
\$13.50 ← Total expense	\$1.50 ← Amount of profit
(1) Profit on Cost	(2) Profit on Selling Price
\$1.50 ÷ \$10 = 0.15 = 15%	\$1.50 ÷ \$15 = 0.10 = 10%

That is, if the dealer bases his per cent of profit on the cost, he is making a profit of 15%; if he bases it on the selling price, he is making a profit of 10%. Since the selling price is the larger number, the per cent based on it is smaller.

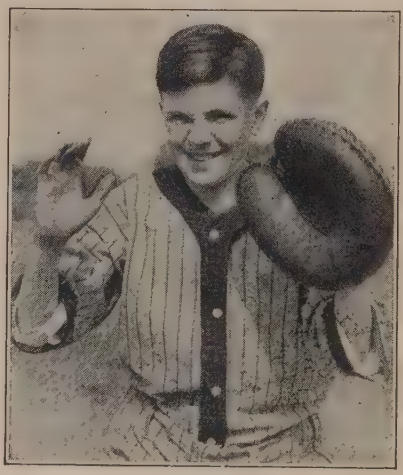
In either case, the amount of profit made by the dealer is the same, but the per cents are different because they are based on different numbers.

In large retail stores there are many reasons why it is better to use the selling-price basis for finding the per cent of profit. But both plans are in use in business, and you should learn how to solve problems about profits in either way. In the examples in this book you will always be told on what you are to find the per cent of profit.

1. On an article for which he paid \$9 a dealer made a profit of 72¢. What per cent of profit did he make on the cost?

2. Mr. Rugg had some farm land which cost him \$2700. Each year he rented it to a farmer for the amount of the taxes, so that there were no expenses. Last year he sold the land for \$3600. What per cent of profit did he make on the cost?

3. When Carl paid \$3.50 for his new mitt, he paid the dealer from whom he bought it 40% more than the dealer paid. How much did the mitt cost the dealer?



4. In Ex. 3, the dealer estimated the overhead on the sale as 80¢. How much profit did he make?

5. In Ex. 4, the profit was what per cent of the cost to the dealer? To the nearest 0.1%, the profit was what per cent of what Carl paid for the mitt?

6. A secondhand automobile dealer paid \$240 for a car which he later sold for \$300. Allowing \$20 as overhead on the deal, find the per cent of profit on the cost.

7. A furniture dealer pays \$30.40 apiece for a certain style of table that he sells for \$42. If the overhead on each sale is \$8.56, what is the per cent of profit on the cost?

8. A hardware dealer pays \$2.70 apiece for planes. If he estimates the overhead as \$1.53, at what price should he sell the planes in order to make a profit of 10% on the cost?

1. On an article which he sells for \$15 a dealer makes a profit of \$1.20. What per cent of profit on the selling price is he making on this article?

2. At the National Market the total of last week's sales was \$2272.50. The week's profits amounted to \$136.35. The profits were what per cent of the sales?

3. On a stock of dress goods which he sold for \$1150 a wholesale dealer made a profit of \$87.40. Find the per cent of profit on the selling price.

4. A store sold for \$12 an article which cost \$7.80. If the allowance for overhead was \$3, what per cent of profit did the store make on the selling price?

5. If a shoe dealer sells for \$8 a pair of shoes for which he pays \$5.60, the margin (overhead + profit) is what per cent of the selling price?

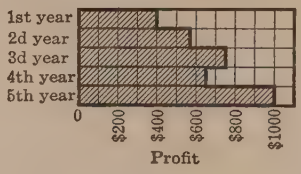
6. In Ex. 5, the cost is what per cent of the selling price? If you know that the cost of an article is \$5.60 and that this cost is 70% of the desired selling price, how can you find the selling price? What is it?

7. Mr. Rice, a furniture dealer, determined the price at which to sell a new line of desks by allowing 40% of the selling price for overhead and profit. The cost of each desk was what per cent of the selling price? If the desks cost him \$30 apiece, at what price should he sell them?

8. A hardware dealer finds that his overhead averages 28% of the selling price of his goods. If he desires a profit of 10% on the selling price, what per cent of the selling price must he allow for overhead and profit? What selling price should he place on an article which costs him \$2.79?

1. Mrs. Harris buys her hats and dresses at the Betty Gray Shop. On a dress for which she paid \$12 the shop made a profit of $12\frac{1}{2}\%$ of the selling price. How much was the profit?

2. Miss Gray, who owns the shop, has worked hard to make it a success. This graph shows how her profits have increased during the 5 yr. that she has run the shop. From the graph tell what the profit was for each year, estimating each answer to the nearest \$25.



3. In Ex. 2, the profit the third year was what per cent more than that of the first year?

4. In Ex. 2, the profit the fourth year was what per cent less than that of the third year?

5. Last year the total sales of the shop amounted to \$11,250, and the expenses of running the shop were \$3375. The expenses were what per cent of the sales?

6. Miss Gray charged \$8 for a hat which cost her \$5. The selling price was what per cent more than the cost?

7. In Ex. 6, if Miss Gray allowed 30% of the selling price for overhead, how much profit did she make? This profit was what per cent of the selling price?

8. On a new line of dresses that she has just bought, Miss Gray wishes to make a profit of 10% of the selling price. If she allows 30% of the selling price for overhead, what per cent of the selling price does she allow for overhead and profit?

9. In Ex. 8, the cost is what per cent of the selling price? What selling price should she place on a dress which costs \$9? \$12? \$21? \$25.50?

MERCHANTS cannot always sell goods at a price that will bring a profit. **If the sum of the cost and overhead is greater than the selling price, there will be a loss.**

Merchants frequently take losses in order to clear their shelves to make room for new goods or to dispose of goods that are going out of style.

1. A dealer sold for \$4 an article which cost him \$5. If the overhead allowance is \$1, what is the sum of the cost and the overhead? What is the amount that he loses on each sale?

2. In Ex. 1, what is the per cent of loss on the selling price? on the cost?

3. A furniture dealer finds that he has bought more than he can sell of a certain style of table which costs \$15.60 each, and on which the overhead allowance is \$5.40. If he sells them at \$18 each, what per cent of the selling price does he lose?

4. A merchant whose overhead averages 30% of the selling price is overstocked on a line of dress goods for which he paid \$1.40 per yard. At what price per yard should he mark the goods in order to get back the cost and the overhead?

Find the per cent of loss on the selling price:

	Cost	Overhead	Selling Price
5.	\$10	\$2.50	\$7.50
6.	\$20	\$5.00	\$20.00
7.	\$15	\$3.00	\$16.00
8.	\$30	\$12.50	\$40.00

	Cost	Overhead	Selling Price
9.	\$5.40	\$1.60	\$6.00
10.	\$9.50	\$3.25	\$10.00
11.	\$8.54	\$1.96	\$7.50
12.	\$16.50	\$7.80	\$22.50

1. The Men's Furnishings Store regularly sells for \$3 each a certain style of shirt that costs \$1.80. If the overhead allowance is 75¢ on each shirt, what per cent of profit does the store make on the regular selling price?

2. In Ex. 1, if the store has a sale at which a discount of 10% is given, what per cent of profit, to the nearest 0.1%, will the store make on the reduced selling price?

3. A dealer regularly sells for \$5 an article which costs him \$2.75. If the overhead allowance is 30% of the selling price, what per cent of profit does the dealer make on the regular selling price of the article?

4. In Ex. 3, if the dealer should sell the article at a discount of 20%, what per cent of profit would he make on the reduced selling price? Notice that in this case the overhead allowance, which is estimated as a per cent of the selling price of the article, is also reduced.

5. A hardware dealer buys hammers at a list price of \$1.50 each, less a trade discount of 40%. If he estimates his overhead at 30% of the selling price, what per cent of profit on the selling price does he make in selling the hammers at the list price of \$1.50 apiece?

6. On a table which regularly sold for \$35 a furniture dealer offered a discount of 40%. The cost of the table was \$24.50, and the overhead allowance was \$7. Will he gain or lose by selling the table at the reduced price? What per cent of the reduced selling price will he gain or lose?

7. If a dealer fixes the selling price of his goods at 50% above cost, the selling price is $1.50 \times$ cost. If he makes a profit of 10% of the selling price, the profit is what per cent of the cost? On an article which costs \$5.40, how much profit does he make?

THE stock of goods on a merchant's shelves represents money invested. If he can turn this stock into money by selling the goods, he will then have money on hand with which to buy more goods that he can sell at a profit.

Another of the merchant's great problems is to secure a rapid turnover of his stock.

As a simple case, suppose that on an article costing \$1 a merchant makes a profit of 5¢. If he sells out his stock of this article 4 times a year, he makes 4 profits of 5¢ each on each dollar invested. His dollar earns 20¢, or 20%, per year.

If a merchant can turn his stock rapidly, he can afford to make a smaller profit and thus sell his goods cheaper.

1. On an article costing \$10 a merchant makes a profit of 50¢. If he can turn his stock of this article 3 times a year, how much profit will he make on each \$10 that he invests in it? This is what per cent of interest per year?

2. If a merchant turns his stock 6 times per year and makes a profit of $3\frac{1}{2}$% on each dollar invested in goods, what rate of interest does his money earn per year?

3. No store can, of course, sell out its entire stock exactly 3, 4, 5, or 6 times a year. Figures on stock-turns represent the average rate at which goods are converted into money. A store that has a stock-turn rate of 5.4 is turning its stock how many times as fast as one with a rate of 2.7?

4. One large chain of stores operates on a profit basis of 2%; that is, they plan their selling prices so as to make 2¢ on each dollar invested in goods. If the stock is turned 5.7 times a year, what rate of interest is earned on the money invested?

CLERKS in stores have to do many problems "in their heads." They have to be **both quick and accurate.** This page shows some of the computations that they can make without using pencil or paper. See how quickly you can do them.

Writing only the answers, in Exs. 1 to 18 find the amount of each sale, and in Exs. 19 to 36 find the answers:

1. 5 lb. cocoa @ 25¢
2. 6 lb. tapioca @ 15¢
3. 4 lb. flour @ $8\frac{1}{2}$¢
4. 2 lb. coffee @ 42¢
5. 8 lb. oatmeal @ 9¢
6. 3 lb. steak @ 41¢
7. 9 doz. eggs @ 51¢
8. $\frac{1}{2}$ doz. oranges @ 48¢
9. 10 lb. sugar @ $9\frac{1}{2}$¢
10. 8 oz. @ 8¢ a pound
11. 1 qt. @ 40¢ a gallon
12. $\frac{1}{2}$ pt. @ 32¢ a quart
13. 7 yd. @ 80¢ a yard
14. 2 pk. @ $1 a bushel
15. 9 eggs @ 52¢ a dozen
16. $2\frac{1}{2}$ lb. @ 40¢ a pound
17. 18 in. @ 80¢ a yard
18. $2\frac{1}{2}$ doz. @ 50¢ a dozen
19. $2 \times \$1.50$
20. $2 \times 75¢$
21. $3 \times \$1.25$
22. $5 \times \$1.40$
23. $36¢ \div 3$
24. $\frac{1}{4}$ of 60¢
25. $\frac{3}{4}$ of $1.20
26. $75¢ + 60¢$
27. $96¢ + 45¢$
28. $91¢ - 40¢$
29. $91¢ - 42¢$
30. $75¢ \div 25¢$
31. $\$6.00 \div 25$
32. $\frac{1}{5}$ of $2.50
33. $\frac{3}{5}$ of $1.50
34. $3\frac{1}{2} \times \$8.00$
35. $41¢ + 19¢ + 37¢$
36. $\$1.00 - 37¢ - 5¢$

Borrowing by the Merchant

SHOULD **a merchant ever borrow money?** Would it not be better for him to wait until he sells enough goods to get the money that he needs in order to buy more goods? The problems below will help you to answer these questions.

1. A merchant needs $5000 with which to buy goods for the fall trade. He knows that he can sell this amount of goods within 3 mo. and make a profit of 8% on their cost. How much profit will he make if he buys the goods?

2. In Ex. 1, if the merchant borrows $5000 for 3 mo. at 6%, how much interest will he have to pay? The profit will be how much more than this? Should he borrow the money?

3. A department store in a city is planning to borrow $40,000 for 3 mo. at 5% and use the money to buy goods. How much will the interest be on this loan?

4. In Ex. 3, the store can make a profit of 10% on money invested in goods. What will be the cost of the goods that will have to be sold in order to pay the interest? Do you think it would be a good plan to borrow the money?

5. A merchant borrowed $15,000 for 4 mo. at 6% and used it to buy goods. How much was the interest? In the 4 mo. he sold $\frac{1}{2}$ of the goods and made a profit of 6% on the cost. How much more or less than the interest did he make?

6. A merchant borrowed $12,000 for 2 mo. at 5% and bought goods with the money. On the sale of the goods he made a profit of $1028.50. Adding the interest to the cost of the goods, find the per cent of profit that he made on the total cost.

IN THE problems on the previous page, you have seen that merchants often borrow money for 2 mo., 3 mo., or some other fraction of a year. In finding interest for parts of a year, you can **often use short cuts that will save work.**

For example, in finding the interest at 6% on a given amount for 2 mo., you know that

$$\text{Interest} = \text{principal} \times \text{rate} \times \text{time}.$$

In this case the time is 2 mo., or $\frac{1}{6}$ yr., and so you have

$$\text{Interest} = \text{principal} \times 0.06 \times \tfrac{1}{6}$$
$$= \text{principal} \times 0.01$$

The interest at 6% for 2 mo. is 1% of the principal, which can be found by simply moving the decimal point in the principal two places to the left.

Using the same plan as above, show that

1. Interest at 4% for 3 mo. is 1% of the principal.
2. Interest at 6% for 1 mo. is $\frac{1}{2}$% of the principal.
3. Interest at 6% for 3 mo. is $1\frac{1}{2}$% of the principal.

Find the numbers that belong in the blank columns:

	Rate of Interest	Time	Per Cent of Principal
4.	4%	6 mo.	
5.	3%	4 mo.	
6.	5%	6 mo.	
7.	2%	6 mo.	
8.	6%	4 mo.	

	Rate of Interest	Time	Per Cent of Principal
9.	6%	8 mo.	
10.	4%	9 mo.	
11.	3%	8 mo.	
12.	8%	3 mo.	
13.	4%	1 mo.	

FOR purposes of computing interest, a year is usually taken as having **12 mo. of 30 da. each, or 360 da. in all.** In making loans to merchants, banks frequently lend the money for periods of 30 da., 60 da., or 90 da.

A 30-day loan made on July 1 is due on July 31, and a 60-day loan made on July 1 is due on Aug. 30. A loan for 1 mo. made on July 1 would not be due until Aug. 1, and a loan for 2 mo. made on July 1 would not be due until Sept. 1. At present, you need not be concerned about this distinction. **Simply take 30 da. as $\frac{30}{360}$ yr., or $\frac{1}{12}$ yr., 60 da. as $\frac{60}{360}$ yr., or $\frac{1}{6}$ yr.,** and so on for similar periods.

The interest at 6% for 60 da. $\left(\frac{1}{6}\text{ yr.}\right)$ is 1% of the principal, which can be found (as on the opposite page) by simply moving the decimal point in the principal two places to the left.

In finding the interest for each of these periods, state the fraction of a year that you would use:

1. 90 da.	3. 60 da.	5. 30 da.	7. 240 da.
2. 120 da.	4. 180 da.	6. 45 da.	8. 300 da.

Find the interest on each of these loans:

	Principal	Rate	Time
9.	$500	6%	60 da.
10.	$500	6%	30 da.
11.	$800	6%	90 da.
12.	$1000	6%	30 da.
13.	$1650	6%	60 da.

	Principal	Rate	Time
14.	$10,000	6%	90 da.
15.	$10,800	6%	90 da.
16.	$12,000	6%	120 da.
17.	$15,500	6%	180 da.
18.	$18,750	6%	240 da.

Interest for Days

MERCHANTS sometimes need to borrow money **for only a few days** in order to pay cash for goods and thus take advantage of discounts on invoices.

Suppose that Carter, Taylor & Co. need to borrow $2400 for 6 da. in order to discount an invoice. If their bank will lend the money at 6%, how much will the interest be?

In finding the interest in this case, you can save work by noticing that **6 da. is $\frac{1}{10}$ of 60 da.** As you have learned, the interest **at 6% for 60 da. is 1%** of the principal, and so in this case the interest will be $\frac{1}{10}$ **of 1%** of the principal.

The interest at 6% for 6 da. is 0.1% of the principal, which can be found by simply moving the decimal point in the principal three places to the left.

The interest on the $2400 for 6 da. will therefore be $2.40.

Interest for 3 da. is $\frac{1}{2}$ of that for 6 da., interest for 12 da. is twice that for 6 da., and so on.

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1. If a merchant borrows $1800 for 12 da. at 6%, how much interest will he have to pay?

2. On a bill amounting to $1450.75 a dealer is allowed a cash discount of 2%. If, by borrowing $1500 for 9 da. at 6%, he can take advantage of this discount, how much more than the interest will he save by so doing?

Find the interest when the amount borrowed (principal), the rate, and the time are as follows:

3. $1700, 6%, 3 da.
4. $8500, 6%, 12 da.
5. $12,500, 6%, 9 da.
6. $36,500, 6%, 18 da.
7. $75,000, 6%, 24 da.
8. $128,500, 6%, 3 da.

1. A merchant borrowed \$12,500 for 30 da. at 6%. How much interest did he have to pay?

2. Which, if either, is the larger,— the interest on \$1200 for 5 mo. at 6% or the interest on \$1200 for 6 mo. at 5%? How much is the interest in each case?

3. A merchant borrowed \$4800 for 90 da. at 6% and used the money to buy goods. If he can sell the goods within the 90 da. at a profit of 10% on the cost, how much more than the interest will he make?

4. A dealer borrowed \$2400 for 12 da. at 6% in order to discount at 2% an invoice amounting to \$2408.50. How much more than the interest did he save by borrowing?

5. In finding the interest on a given amount for 9 da. at 4%, what per cent of the principal can you take?

Find these per cents:

6. 6% of \$1240
7. 2% of \$1685
8. $\frac{1}{2}$% of \$1160
9. $1\frac{1}{2}$% of \$8450
10. $\frac{1}{2}$% of \$1750
11. 4% of \$2450
12. 3% of \$1675
13. $\frac{2}{3}$% of \$1200
14. 5% of \$2750
15. $\frac{3}{4}$% of \$1680
16. $\frac{1}{2}$% of \$7690
17. 8% of \$3460

Find the interest when the principal, the time, and the rate are as follows:

18. \$900, 60 da., 6%
19. \$1250, 90 da., 6%
20. \$2840, 30 da., 6%
21. \$12,800, 12 da., 6%
22. \$8500, 90 da., 4%
23. \$16,000, 9 da., 4%
24. \$14,650, 30 da., 6%
25. \$45,550, 90 da., 6%

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. Tony delivered 142 magazines last week. He made $1\frac{1}{2}¢$ on each copy. At this rate, how much will Tony earn in a year (52 wk.)?

2. At an average of 125 mi. per day, how many days will it take for an automobile trip of 1125 mi.?

3. At $1.60 per hour, how much will a carpenter earn in a week in which he works 8 hr. a day for $5\frac{1}{2}$ da.?

4. At $3\frac{3}{4}\%$, what will be a real-estate salesman's commission for selling a house for $14,800?

5. When he bought his house, Mr. Burns borrowed $5800 at $5\frac{1}{2}\%$. How much interest does he have to pay per year?

6. A dealer paid $3.50 each for some lamps. For how much should he sell them in order to get 40% more than the cost?

7. A traveling salesman sold $4250 worth of goods last week. At $2\frac{1}{2}\%$, how much commission did he earn?

8. Last year our football team scored 120 points. Tom scored 54 of them. What per cent of the points did Tom score?

9. The Atlas Department Store borrowed $8600 for 12 da. at 6%. How much was the interest?

10. A dealer ordered goods amounting to $1680 at list prices. He was allowed a trade discount of 35% and 2% extra for cash. If he paid cash, how much did the goods cost?

SHOULD **an individual ever borrow money?** You have seen that the merchant often finds it to his advantage to do so. Sometimes this is also true for the individual, **but more often it is not.**

It is often easier to borrow money than to pay it back.

1. Mr. Paine pays $80 a month for the rent of the house in which he lives. How much does he pay per year?

2. Mr. Paine can buy a house for $8000. If he borrows the entire amount at $5\frac{1}{2}\%$, how much will the yearly interest be?

3. In addition to the interest, it will cost Mr. Paine $234.50 a year for taxes, insurance, and repairs. How much will it cost in all per year? This is how much less than his present rent?

4. If Mr. Paine pays off $1000 a year on his loan, in how many years will it be entirely paid off? If the expenses of owning the house by that time are $294 per year, how much will it then cost Mr. Paine per month to own it?

5. Would you advise Mr. Paine to borrow the money and buy the house? Give reasons for your answer.

6. Mr. Reed bought a house for $10,500 by paying $2500 down and the rest in 8 equal installments a year apart. He had to pay interest on the unpaid balance at 6%. How much was the interest the first year? the second? the fifth?

Find the total interest paid on each of these loans:

7. $6000, 6%, 3 yr.
8. $9000, $5\frac{1}{2}\%$, 2 yr.
9. $12,000, 6%, $2\frac{1}{2}$ yr.
10. $8500, $4\frac{1}{2}\%$, 1 yr. 6 mo.
11. $10,000, $5\frac{1}{2}\%$, 2 yr. 6 mo.
12. $14,800, 6%, 2 yr. 9 mo.

OCCASIONALLY in some private transaction or in the settlement of claims, as by court decisions, it is necessary to compute interest for years, months, and days.

For example, suppose that a claim for $1800, dated May 21, 1930, is not settled until Feb. 3, 1933. If interest at 6% is due from the date of the claim, how much must be paid to settle it?

The first step is to find the time. You already know how to do this kind of subtraction by writing the dates as here shown and taking 30 da. to the month.

yr.	mo.	da.	
1933	2	3	← Date settled
1930	5	21	← Date of claim
2	8	12	← Time

The other steps, as shown in the work below, are to find the interest for 1 yr., then for 2 yr. 8 mo., then for 12 da., and finally, by addition, for the total time of 2 yr. 8 mo. 12 da.

$1800 ← Amt. of claim	$1.80 ← Int. (6 da.)
× 0.06 ← Rate	× 2
$108.00 ← Int. (1 yr.)	$3.60 ← Int. (12 da.)
× $2\frac{2}{3}$ ← 2 yr. 8 mo.	+ 288.00 ← Int. (2 yr. 8 mo.)
72 00	$291.60 ← Total int.
216 00	+ 1800.00 ← Amt. of claim
$288.00 ← Int. (2 yr. 8 mo.)	$2091.60 ← *Ans.*

You will not often have to solve problems like this, but you can easily learn how it is done, if your teacher tells you to do so, by studying the work above and making sure that you understand each step. Notice that the interest for 6 da. is found by the method on page 108.

1. Mr. Sinclair borrowed $850 at 6%. If he should not pay it back until 1 yr. 6 mo. later, how much would he have to pay, including principal and interest?

2. In Ex. 1, suppose that Mr. Sinclair had kept the money 18 da. longer. How much would he have then had to pay?

3. A claim for $1250 was allowed to run 1 yr. 9 mo. 3 da. before it was settled. If interest at 6% was due for the whole period, how much was paid in settling the claim?

4. A claim for $2450, dated Aug. 28, 1930, was settled on Jan. 12, 1934, with interest at 6% from the date of the claim. What was the amount of the settlement?

5. While going over some old papers that had belonged to his grandfather, Mr. James found one which showed that on Sept. 5, 1868, his grandfather loaned a man $720 at 4%. Apparently, neither interest nor principal had ever been paid. Just for fun, Mr. James figured up how much it would take on Jan. 7, 1931, the day he found the paper, to settle this old debt with interest for the whole period. How much was it?

Find the amounts that belong in the blank column:

	Principal	Rate	Time	Interest
6.	$950	6%	2 yr. 6 mo. 18 da.	
7.	$1280	4%	2 yr. 8 mo. 27 da.	
8.	$2500	6%	2 yr. 6 mo. 15 da.	
9.	$8700	6%	3 yr. 8 mo. 9 da.	
10.	$14,500	4%	3 yr. 3 mo. 3 da.	
11.	$27,250	6%	2 yr. 10 mo. 21 da.	

1. Mr. Hall is paying \$6.50 per month for the rent of a garage in which to keep his car. To how much does Mr. Hall's garage rent amount per year?

2. Mr. Hall finds that for \$800 he can have a two-car garage built in his own yard. If he borrows the money at 6%, the interest per year will be how much less than he is now paying as rent?

3. If Mr. Hall rents half of the garage to Mr. Somes for \$6.50 per month, how much does Mr. Somes pay per year? Adding this to Mr. Hall's savings on his own rent, how much more than the interest is this per year?

4. If Mr. Hall pays off \$100 at the end of each year on the principal, by how much does he reduce the yearly interest? Make a table showing how much Mr. Hall pays in principal and interest for each of the 8 yr. and how much he receives as rent and as savings on his own rent. Find how much he gains or loses by borrowing the money and building the garage.

5. A man borrows \$12,000 at $5\frac{1}{2}\%$ in order to buy a house. How much is the first year's interest? If each year he pays off \$1000 on the principal, in how many years will it all be paid? Make a table showing how much the man pays in principal and interest each year, and find the total amount of interest that he has to pay.

Per Cents and Fractions

1. How do the columns at the right show that $25\% = \frac{1}{4}$? that $50\% = \frac{1}{2}$? that $75\% = \frac{3}{4}$? that $100\% = 1$?

2. Show from the columns that 25% is $\frac{1}{2}$ of 50%, $\frac{1}{3}$ of 75%, and $\frac{1}{4}$ of 100%.

3. Show from the columns that 50% is $\frac{2}{3}$ of 75%, $\frac{1}{2}$ of 100%, and $2 \times 25\%$.

			25%
		25%	25%
	25%	25%	25%
25%	25%	25%	25%
25%	50%	75%	100%

4. Taking $12\frac{1}{2}\%$ instead of 25%, make eight columns like those above. From them show that $12\frac{1}{2}\% = \frac{1}{8}$.

As in Ex. 4, show from the columns of per cents that

5. $12\frac{1}{2}\% = \frac{1}{4}$ of 50%
6. $25\% = \frac{2}{3}$ of $37\frac{1}{2}\%$
7. $37\frac{1}{2}\% = \frac{3}{8}$
8. $87\frac{1}{2}\% = \frac{7}{8}$
9. $62\frac{1}{2}\% = \frac{5}{8}$
10. $100\% = \frac{8}{8}$

11. An inch is what per cent of 6 in.? of 1 ft.?

12. A foot is what fraction of 1 yd.? what per cent of 1 yd.?

13. A quart is what fraction of 1 gal.? It is what per cent of 1 gal.? of 2 gal.?

14. A nickel is what per cent of a dime? of 25¢? of $1?

Read as fractions, whole numbers, or mixed numbers:

15. 50%
16. 75%
17. 10%
18. 40%
19. 25%
20. 80%
21. $12\frac{1}{2}\%$
22. 100%
23. 125%
24. 400%

Using short methods, find these per cents:

25. $33\frac{1}{3}\%$ of 93
26. $12\frac{1}{2}\%$ of 96
27. 75% of 40
28. 20% of 50
29. $37\frac{1}{2}\%$ of $160
30. $62\frac{1}{2}\%$ of $320

1. Mr. Morton's salary last year was \$3120. This year it has been increased 15%. How much is his salary now?

2. When wages for carpenters are increased from \$1.50 per hour to \$1.65 per hour, what is the per cent of increase?

3. Mr. Carr had \$500 in the bank and drew out 50% of it. How much was left? By what per cent must he increase his balance in the bank in order to have \$500 again?

4. On an investment of \$720, Mr. Rice made a profit of $12\frac{1}{2}$% of the amount invested. How much did he gain?

5. It is 1640 yd. from Jim's house to the school. By going across the park, he saves 410 yd. What per cent of the distance from his house to the school does he save?

6. Mrs. Crowell's gas bills for cooking have been averaging \$3.80 per month. If, by being more careful, she reduces this average to \$3.40 per month, what per cent of the larger amount, to the nearest 0.1%, does she save?

7. By buying a winter coat at a sale at which a discount of $33\frac{1}{3}$% was given, Mr. Roe saved \$14.75. What was the original price of the coat?

8. Last year there were 475 accidents in a factory. This year, after the workers were urged to be more careful, there were only 64% as many. How many were there this year?

9. In running an automobile, the cost of gasoline is usually estimated as 20% of the total running expenses. Last year Mr. Robinson spent \$108.40 for gasoline. About how much should it have cost him to run his car last year?

10. In Ex. 9, the cost of motor oil is usually estimated as 3% of the expenses of running a car. About how much should Mr. Robinson have spent for motor oil last year?

1. How many pupils are there in your class? What per cent are boys? What per cent are girls?

2. Betty Dean's mark on an arithmetic test was 80%. She had 6 examples wrong. What per cent of all the examples were wrong? How many examples were there in the test?

Find the numbers that belong in the blank spaces below:

	Number of Examples	Number Right	Per Cent Right	Number Wrong	Per Cent Wrong
3.	40	30	_____%	_____	_____%
4.	60	_____	_____%	10	_____%
5.	50	_____	90%	_____	_____%
6.	_____	20	_____%	_____	20%
7.	48	_____	_____%	0	_____%

1. A wholesale business house paid one of their traveling salesmen $3850 last year in commissions. This year his commissions increased 22%. How much did he receive this year?

2. A furniture dealer marks a chair for which he paid $7.50 at 40% more than the cost. What is the marked price?

3. On an article which sells for $14.50 a dealer makes a profit of 8% of the selling price. How much is the profit?

4. In order to get rid of old stock, a dealer sold some articles which cost him $18.60 each at 15% less than the cost. At what price did he sell them?

5. The total sales of the Gray Store were $145,455 last year. The overhead expenses of the store were $40,727.40. The overhead was what per cent of the sales?

6. In a store where 30% of the selling price is allowed for overhead, what is the allowance for overhead on an article that sells for $7? for $12.50? for $54.50?

7. In a store that allows 25% of the selling price for overhead, what per cent of the selling price should be allowed for overhead and profit on an article on which a profit of 10% of the selling price is desired? The cost of the article represents what per cent of the selling price?

8. In Ex. 7, what selling price should be placed on an article that costs $6.50? $9.75? $35.75?

9. A department store needs $35,000 with which to buy goods for the fall trade. If the store can borrow this money from a bank at 6%, how much will the interest be for 3 mo.?

10. In Ex. 9, suppose that the store can make a profit of 12% on money invested in goods. How much more than the interest can they make if they sell all the goods within the 3 mo.?

Tell how you would solve each of these problems if the numbers that belong in the blank spaces were given:

1. Mabel Joyce earns $—— a week in a store. If she saves $—— a week, what per cent of her income does she save?

2. The Jefferson School had —— pupils last year, and this year it has ——% less. How many pupils are there this year?

3. Mr. Wills borrowed $—— for —— mo. at ——%. How much interest did he have to pay?

4. In a history test, Mollie answered —— questions correctly and Kate answered ——. Mollie answered what per cent more (or less) than Kate?

5. By buying his coal in the spring, instead of waiting until fall, Mr. Mooney saves ——¢ a ton on the fall price of $—— a ton. What per cent of the fall price does he save?

6. In an arithmetic test, George solved —— of the examples correctly and received a mark of ——%. How many examples were there in the test?

7. Ice weighs ——% less than water. A cubic foot of water weighs —— lb. What is the weight of a cubic foot of ice?

8. The Regal Furniture Co. marked a set of bedroom furniture, which cost $——, at ——% more than the cost. What selling price was placed on the set?

9. Mr. Dean can buy a new car for $—— or a used car for ——% less than the price of the new one. How much can he save by buying the used car?

10. From money which is invested at an average rate of ——%, a college receives an income of $—— per year. What is the amount of money invested?

1. Taking the numbers 45 and 90, find (1) their sum, (2) their difference, (3) their product, (4) the quotient of the larger divided by the smaller, and (5) the quotient of the smaller divided by the larger.

Find the sum, difference, product, and both quotients for each of these pairs of numbers:

2. 32 and 512
3. 25 and 625
4. 27 and 1323
5. 98 and 2646
6. 360 and 12,960
7. 4809 and 38,472

As before, find the sum, difference, product, and both quotients in each of these cases:

8. $\frac{5}{8}$ and $\frac{3}{4}$
9. 2 and $\frac{7}{8}$
10. $1\frac{1}{2}$ and $4\frac{1}{2}$
11. $3\frac{1}{3}$ and 10
12. $\frac{1}{2}$ and $1\frac{1}{3}$
13. $1\frac{1}{6}$ and $3\frac{1}{2}$
14. $\frac{1}{2}$ and 4
15. $1\frac{1}{2}$ and 3
16. $3\frac{1}{3}$ and $33\frac{1}{3}$

In these examples the first number is the product of two numbers and the second is one of them. Find the other number:

17. 2256, 47
18. 1128, 24
19. 2430, 45
20. 4860, 54
21. \$840, 35%
22. \$570, 190

23. \$7.50 is $\frac{1}{5}$ of what number? 5% of what number?

24. \$4.50 is 50% of what number? 75% of what number?

25. \$47.82 is what per cent of \$95.64? of \$47.82? of \$23.91?

26. What number is $12\frac{1}{2}$% more than 80? $12\frac{1}{2}$% of 80?

27. Using your pencil only to write the answer, multiply 168 by 25; by 125; by $33\frac{1}{3}$; by $16\frac{2}{3}$.

28. Find the net amount of an order for goods amounting to \$1600 at list prices and sold at a discount of 15%, 10%.

Last Half

CHAPTER THREE

BANKS AND INVESTMENTS

I. DOING BUSINESS WITH THE BANK

What a Checking Account is

YOU have already learned about depositing money in savings banks, where the money will not only be safe but will also earn an income in the form of interest. In such banks, the depositor usually has to go to the bank with his bank book whenever he wishes to deposit or draw out money.

Anyone who hopes to succeed should have a savings account and should try to add something to it each month.

For people who need to draw out money frequently, it would be inconvenient to have to go to the bank each time. Such people deposit money in banks where they can draw it out or have it paid to others by means of a written order called a **check.** On page 123 you will find a picture of the check that Mr. George Rice wrote when he wanted to pay his coal dealer (Mr. Cate) $27.50 from the money that he (Mr. Rice) had on deposit in his account at the First National Bank.

A bank account of this kind is generally called a **checking account.** Such accounts **do not usually pay interest** on small amounts. Some banks have different departments for checking accounts and savings accounts. In a savings department, interest is paid as in any savings bank.

1. Whenever Mr. Rice deposits money in his account at the First National Bank, he fills out a deposit slip like the one here shown. In listing the checks which he is depositing, he puts down the name of the bank on which the check is drawn (written) if it is located in Toledo; otherwise he puts down the name of the place in which the bank is located. Check the addition on this slip.

DEPOSITED BY
George Rice
1136 Western Ave.
IN
THE FIRST NATIONAL BANK
TOLEDO, OHIO
Date Feb 9, 19—

	Dollars	Cents
Bills	42	00
Coin	1	58
Checks:		
First National	38	75
Houston, Texas	9	60
Columbus, Ohio	78	40
	170	33

Write deposit slips for these items, using your own name as depositor and the name of some bank you know:

2. Bills, $126; coin, $32.50; check on Ranchers Exchange Bank, $87.75; check on Planters Trust Co., $142.50.

3. Bills, $210; check on Fruit Growers Bank, $18.50; check on National Trust Co., $129.60; check on First City Bank, $17; check on Third National Bank, $24.36.

4. Coin, $84.35; check on a Dallas bank, $31.50; check on a New York bank, $408.20; check on a Baltimore bank, $23.70; check on a New Orleans bank, $18.32.

5. Bills, $270; coin, $21.67; check on a Chicago bank, $8.40; check on an Akron bank, $90.78; check on an Omaha bank, $38.90; check on a Galveston bank, $106.04; check on an Atlanta bank, $66.70; check on a Boston bank, $98.42.

WHEN Mr. Rice wishes to pay Mr. Cate $27.50 for some coal that he has ordered, he fills out, as shown below, one of the **blank checks** in the **check book** which the bank furnishes him. He then tears out the check on the dotted line indicated by the arrow and either gives or sends it to Mr. Cate.

No. 286		
Date Feb. 9, 19 —		
To John Cate		
For Coal		
Bal. forward	127	86
Am't deposited	170	33
Total	298	19
Am't this check	27	50
Bal. forward	270	69

THE FIRST NATIONAL BANK

Toledo, Ohio, Feb. 9, 19____

Pay to the order of John Cate $27.50

Twenty-seven and 50/100 Dollars

No. 286 George Rice

Stub ↑ Check

On the **stubs**, which are left in the check book, Mr. Rice puts down the amounts that he deposits and the amounts of his checks, and thus keeps a record of his **bank balance.**

In the above check, Mr. Rice is called the **maker** and Mr. Cate the **payee.** In order to collect the money for the check, Mr. Cate must **indorse** it by writing his name **across the back at the stub end.** If he deposits the check at his bank, as he probably will, he may indorse it as here shown, or he may write "Pay to the order of The Second National Bank" above his name. Such indorsements prevent the check from being cashed if lost.

For deposit only in
The Second National Bank
John Cate

If a check indorsed simply with the payee's signature is lost, anyone who finds it can cash it.

1. Write a check, like the one on page 123, for $46.28, making up names and a date, and sign it with the name "John Doe" as maker. **Be careful not to leave any blank spaces in which someone else could write other words or figures.** Fill all such spaces with a wavy line.

As in Ex. 1, write checks for the following amounts:

2. $8.75	4. $125.00	6. $200.00	8. $8000.00
3. $25.60	5. $145.60	7. $475.50	9. $1250.75

10. John Doe makes out a check payable to the order of Richard Roe. Mr. Roe wishes to deposit it at his bank, the City Trust Co. Write Mr. Roe's indorsement.

11. In Ex. 10, suppose that instead of depositing the check Mr. Roe wishes to give it to Thomas Wye in part payment of a bill. Write the indorsement that would make the check payable to Mr. Wye's order.

12. In Exs. 10 and 11, who was the maker of the check? Who was the original payee? After Mr. Roe indorsed it to Mr. Wye, to whom was the check payable? What would Mr. Wye have to do in order to cash the check?

13. After he wrote the check shown on page 123, Mr. Rice's bank balance was $270.69. The next day he deposited $34.20 and drew two checks, one for $17.65 and the other for $75. What balance did his check book show then?

14. At the beginning of one week, Mr. Rice's balance was $315.88. During the week he made the following deposits: $18.50, $26.80, $56.75, $42.96. He drew checks as follows: $8.15, $22.80, $40.60, $9.70, $6.55, $25, $12.34. How much was his balance at the end of the week?

15. Mrs. Rice had $168.14 in the bank before she wrote these checks: milk, $8.04; groceries, $16.28; gas, $3.80; telephone, $3.65; rent, $45. What was her balance after this?

There is at least one mistake in each of these check stubs. Find the mistake and then write each stub correctly:

16.

No. 392
Date Dec 6, 19—
To E. K. Fox
For Labor

Bal. forward	172	60
Am't deposited	28	52
Total	201	12
Am't this check	14	68
Bal. forward	286	44

17.

No. 393
Date Dec 8, 19—
To R. J. West
For Clothes

Bal. forward	286	44
Am't deposited	8	22
Total	278	22
Am't this check	42	50
Bal. forward	235	72

18.

No. 394
Date Dec. 8, 19—
To M. R. Hall
For Repairs on car

Bal. forward	235	72
Am't deposited		
Total	235	72
Am't this check	18	75
Bal. forward	254	47

Here is a bank's record of depositors' accounts. Find the numbers that belong in the last column and the column totals:

	Depositor	Yesterday's Balance	Deposits Received	Checks Paid	Today's Balance
19.	A	$248.60	$80.15	$32.27	$296.48
20.	B	317.77	15.60	82.70	
21.	C	691.04		142.60	
22.	D	109.36	28.72		
23.	E	1215.84	108.30	219.77	
24.	F	1405.13	96.50	468.42	
25.	G	908.71	125.60	256.18	
26.	Totals				

AT THE end of a month, banks usually send each depositor a statement of his account, and return with the statement the checks paid from his account during the month. Here is a statement such as is sent out by a city bank:

THE ELEVATED NATIONAL BANK
Chicago, Illinois

Coles & Wiggin
1142 Eastern Ave.
Chicago, Ill.

Statement for the month of April, 19—

Day	Debits	Day	Credits	Day	Balance
		1	Brought forward		1 236.40
		2	687.50	2	1 923.90
3	42.78				
	2.60			3	1 878.52
		8	300.00	8	2 178.52
12	272.76			12	1 905.76
		20	350.00	20	2 255.76
25	250.00			25	2 005.76
28	27.90			28	1 977.86
		30	Carried forward		1 977.86

The amounts of the checks paid are entered in the **debits** column, and the amounts deposited are entered in the **credits** column. The balance each day is found by adding the credits to the previous day's balance and subtracting the debits. The amount **brought forward** under date of April 1 is the balance from the previous month's statement (March), and the amount **carried forward** under date of April 30 is the balance on the last day, which is carried to the next month (May).

The depositor should compare the bank's statement with the record of his balance as kept in his own check book. Any mistakes in the bank's statement **should be reported immediately,** so that they may be corrected.

In the statement on page 126, tell how each of these daily balances was found and check the work to see if it is correct:

1. 2d, $1923.90
2. 3d, $1878.52
3. 8th, $2178.52
4. 12th, $1905.76
5. 25th, $2005.76
6. 28th, $1977.86

7. Mr. Rice's bank statement for March showed a balance of $308.66 on Mar. 31. During April he deposited a total of $682.75 and drew checks amounting to $596.97. How much was his bank balance on Apr. 30?

8. With his April statement, the bank returned to Mr. Rice a canceled (paid) check that he had given to Mr. Drew. How does this check serve as a receipt to show that Mr. Rice has paid Mr. Drew what he owes him?

9. In checking his bank statement one month, Mr. Rice found that his balance, as shown in his check book, was $415.26. The bank statement, which was correct, showed a balance of $408.77. Mr. Rice found that he had forgotten to put down on the stub the amount of one check that he had drawn. What was the amount of this check?

Here are some computations such as are used in checking a bank statement. See if you can do them correctly:

10. From $428.30 subtract the sum of $62.83 and $21.42.

11. Find the sum of $703.20, $38.60, and $107.64, and from it subtract the sum of $39.60 and $98.45.

12. Subtract the sum of $29.68, $33.87, and $129.69 from the sum of $863.89, $95.00, $38.05, and $120.08.

13. To a balance of $1083.75 add credits of $42.68, $38.05, $125.00, and $3.50 and then subtract debits of $29.30, $100.00, $45.70, and $83.42.

1. Mr. Roe works $5\frac{1}{2}$ da. each week and earns \$32.50 per week. Last winter, when he was sick, he could not work for 22 da. How much did he lose in wages?

2. From a cheese that weighed $18\frac{1}{2}$ lb. a grocer sold four pieces that weighed 1 lb. 8 oz., $\frac{1}{2}$ lb., 3 lb., and 2 lb. 12 oz. How many pounds and ounces were left?

3. When Mr. Wayne sold Mr. Lawton's house for \$9500, he received \$332.50 as his commission. What rate of commission did Mr. Wayne charge?

4. A hardware dealer wishes to get 40% more than the cost for an article for which he pays \$4.75. At what price should he mark it?

5. A business house borrowed \$42,500 for 3 mo. at 6%. How much was the interest on the loan?

6. Mr. Teel's bank balance is \$206.37. After he deposits \$45.75 and draws checks for \$18.40, \$7.29, and \$14.50, how much will his balance be?

See how quickly you can do these examples:

7. $14\frac{3}{4}$	**8.** $19\frac{1}{2}$	**9.** \$5.60	**10.** \$1875
$-8\frac{7}{8}$	$+11\frac{5}{8}$	$\times 1.50$	$\times 0.05$
11. 28	**12.** $44\frac{1}{2}$	**13.** \$128.76	**14.** \$248.39
$\times 2\frac{1}{2}$	$\times 3\frac{1}{4}$	$+75.25$	-84.72

See if you can do these divisions correctly:

15. $27\frac{3}{4} \div 3$	**17.** $36 \div 4\frac{1}{2}$	**19.** \$1.31 ÷ \$32.75
16. $16\frac{1}{2} \div 2\frac{3}{4}$	**18.** \$4.50 ÷ 0.05	**20.** \$37.50 ÷ \$1250

Reviewing the Six-Per-Cent Method

AS YOU have already learned, business men often borrow money from banks for 30 da., 60 da., or 90 da. You have also learned the short way of finding the interest on such loans at 6%. This is often called the **six-per-cent method.** Here is what you need to remember about it:

The interest at 6% for 60 da. is 1% of the principal, which is found by moving the decimal point in the principal two places to the left.

The interest at 6% for 6 da. is 0.1% of the principal, which is found by moving the decimal point in the principal three places to the left.

The interest for 30 da. is $\frac{1}{2}$ of that for 60 da., the interest for 90 da. is $1\frac{1}{2}$ times that for 60 da., and so on.

---

1. When Mr. Rice was borrowing \$1750 for 60 da. at 6%, the clerk at the bank told him at once that the interest would be \$17.50. How did he know it?

State the interest at 6% for 60 da. and also for 6 da. on

2. \$150	5. \$740	8. \$1000	11. \$12,200
3. \$200	6. \$860	9. \$1700	12. \$14,500
4. \$370	7. \$920	10. \$1820	13. \$45,750

State the interest at 6% for 30 da. and also for 90 da. on

14. \$400	16. \$1500	18. \$1250	20. \$15,000
15. \$800	17. \$2200	19. \$1850	21. \$25,000

WHEN the class was studying the six-per-cent method of finding interest, they chose Jim Rice to go to some bank and find out anything he could about it. Jim talked to one of the men at the bank. The man showed Jim how the method could be used in finding interest for periods other than 30 da., 60 da., or 90 da.

He wrote	He thought
\$7.20 ←	Int. for 120 da. (2 × \$3.60)
1.80 ←	Int. for 30 da. ($\frac{1}{2}$ × \$3.60)
1.20 ←	Int. for 20 da. ($\frac{1}{3}$ × \$3.60)
\$10.20 ←	Int. for 170 da.

The work at the right shows how the man at the bank found the interest at 6% on \$360 for 170 da. He simply wrote the three amounts in a column, added them, and said that the interest was \$10.20. Check the work to see if he was right.

1. How would you find the interest at 6% on \$320 for 66 da.? How much is it?

2. In finding the interest at 6% on \$600 for 70 da., you can first find it for 60 da. How much is it? How can you then find it for 10 da.? How much is the interest for the 70 da.?

Find the interest at 6% in each of these cases:

3. \$250, 66 da.
4. \$300, 80 da.
5. \$360, 72 da.
6. \$420, 96 da.
7. \$540, 42 da.
8. \$1000, 78 da.
9. \$1500, 100 da.
10. \$1800, 75 da.
11. \$2400, 108 da.
12. \$4200, 136 da.
13. \$12,000, 40 da.
14. \$18,900, 80 da.
15. \$27,600, 100 da.
16. \$45,000, 86 da.
17. \$64,500, 160 da.

THE man at the bank also told Jim that the six-per-cent method could be used in finding interest at other rates. He showed Jim this way of finding the interest at 5% on \$360 for 66 da. He said that he took off $\frac{1}{6}$ because 5% is $\frac{5}{6}$ of 6%, and the easiest way to find $\frac{5}{6}$ of a number is to find $\frac{1}{6}$ of it and then subtract, as here shown.

He wrote	He thought
\$3.60	← Int. at 6% for 60 da.
+ .36	← Int. at 6% for 6 da.
\$3.96	← Int. at 6% for 66 da.
− .66	← Take off $\frac{1}{6}$
\$3.30	← Int. at 5% for 66 da.

The man then asked Jim how he would find interest at 7% by this method. What should Jim have answered?

Find the interest at 5% in each of these cases:

1. \$240, 60 da.
2. \$720, 30 da.
3. \$840, 90 da.
4. \$960, 36 da.
5. \$1260, 66 da.
6. \$1920, 93 da.

Find the interest at 7% in each of these cases:

7. \$540, 60 da.
8. \$612, 30 da.
9. \$1560, 90 da.
10. \$1890, 72 da.
11. \$8640, 18 da.
12. \$2880, 80 da.

Find the interest at 4% in each of these cases:

13. \$390, 30 da.
14. \$570, 60 da.
15. \$1260, 20 da.
16. \$1170, 36 da.
17. \$5760, 72 da.
18. \$7380, 40 da.

Find the interest at $4\frac{1}{2}$% in each of these cases:

19. \$480, 60 da.
20. \$640, 30 da.
21. \$1080, 90 da.
22. \$1240, 66 da.
23. \$7440, 50 da.
24. \$8520, 100 da.

THE man at the bank also told Jim that the people there rarely used any of the methods of finding interest taught in school. He said that they **found interest by using tables,** and showed Jim a big book containing many pages. Here is a small table showing the interest on $1000 at four different rates. From this you can see how a large table would be used.

Time	4%	5%	6%	7%	Time	4%	5%	6%	7%
1 da.	0.111	0.139	0.167	0.194	20 da.	2.222	2.778	3.333	3.889
2 da.	.222	.278	.333	.389	30 da.	3.333	4.167	5.000	5.833
3 da.	.333	.417	.500	.583	40 da.	4.444	5.556	6.667	7.778
4 da.	.444	.556	.667	.778	50 da.	5.556	6.944	8.333	9.722
5 da.	.555	.694	.833	.972	60 da.	6.667	8.333	10.00	11.67
6 da.	.667	.833	1.000	1.167	70 da.	7.778	9.722	11.67	13.61
7 da.	.778	.972	1.167	1.361	80 da.	8.889	11.11	13.33	15.56
8 da.	.889	1.111	1.333	1.555	90 da.	10.00	12.50	15.00	17.50
9 da.	1.000	1.250	1.500	1.750	6 mo.	20.00	25.00	30.00	35.00
10 da.	1.111	1.389	1.667	1.944	1 yr.	40.00	50.00	60.00	70.00

In the table above, the interest on $1000 for 1 da. at 4% is given as 0.111. This means $0.111, which is 11.1¢, or 11¢ to the nearest cent.

Study the work at the right; it shows how to find the interest on $2500 at 5% for 75 da.

$9.722 ← Int. on $1000 for 70 da.
+ .694 ← Int. on $1000 for 5 da.
$10.416 ← Int. on $1000 for 75 da.
× $2\frac{1}{2}$ ← $2500 = $2\frac{1}{2}$ × $1000
5 208 ← $\frac{1}{2}$ × 10.416
20 832 ← 2 × 10.416
$26.040 ← Int. on $2500 for 75 da.

To the nearest cent, the answer is $26.04. Check it by the six-per-cent method, and see if the results agree.

In the tables used by banks there are more decimal places, so that interest can be found correct to the nearest cent.

Giving the answers to the nearest cent, find directly from the table the interest on $1000 for these periods and rates:

1. 6 da., 7%
2. 50 da., 5%
3. 9 da., 4%
4. 80 da., 6%
5. 8 da., 7%
6. 40 da., 5%

7. On page 132 the interest on $2500 was found by multiplying the interest on $1000 by $2\frac{1}{2}$. By what number would you multiply in finding the interest on $5000? on $7500? on $1250? on $2400? on $38,000?

8. The interest on $100 is $\frac{1}{10}$ of the interest on $1000. From the interest on $1000, how would you find the interest on $500? on $250? on $750? on $300? on $10? on $20?

Using the table, find the interest in each of these cases:

9. $1000, 68 da., 7%
10. $2000, 40 da., 4%
11. $2500, 36 da., 5%
12. $3500, 72 da., 6%
13. $8250, 24 da., 5%
14. $12,000, 69 da., 4%
15. $100, 80 da., 7%
16. $400, 32 da., 5%
17. $250, 54 da., 6%
18. $750, 18 da., 4%
19. $450, 92 da., 6%
20. $560, 38 da., 5%

21. Mr. Jones owes $4500 which he borrowed 2 mo. 6 da. ago at 5%. He wishes to pay the loan today. Using the table and taking 30 da. to the month, find how much interest he will have to pay.

As in Ex. 21, find the interest in each of these cases:

22. $1500, 3 mo. 5 da., 4%
23. $6500, 1 mo. 8 da., 7%
24. $8200, 3 mo. 12 da., 6%
25. $750, 6 mo. 8 da., 5%
26. $640, 3 mo. 7 da., 4%
27. $1280, 2 mo. 18 da., 6%

JIM told the class that the man at the bank said that in computing interest a banker generally uses the exact number of days. For example, in computing interest from Jan. 15 to Aug. 8 of the same year, the exact number of days is first found from a table something like the one below. The interest is then computed for this time by using an interest table.

To → / From ↓	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Jan.	365	31	59	90	120	151	181	212	243	273	304	334
Feb.	334	365	28	59	89	120	150	181	212	242	273	303
Mar.	306	337	365	31	61	92	122	153	184	214	245	275
Apr.	275	306	334	365	30	61	91	122	153	183	214	244
May	245	276	304	335	365	31	61	92	123	153	184	214
June	214	245	273	304	334	365	30	61	92	122	153	183
July	184	215	243	274	304	335	365	31	62	92	123	153
Aug.	153	184	212	243	273	304	334	365	31	61	92	122
Sept.	122	153	181	212	242	273	303	334	365	30	61	91
Oct.	92	123	151	182	212	243	273	304	335	365	31	61
Nov.	61	92	120	151	181	212	242	273	304	334	365	30
Dec.	31	62	90	121	151	182	212	243	274	304	335	365

The above table gives the exact number of days between the same dates in each month. If you follow along the horizontal line marked "Jan." to the column marked "Aug.," you will find 212. This means that it is 212 da. from Jan. 15 to Aug. 15, and so from Jan. 15 to Aug. 8 it is 7 da. less, or 205 da.

Using the table, find the exact number of days from

1. May 15 to Nov. 15
2. May 15 to Nov. 21
3. May 15 to Nov. 12
4. July 24 to Sept. 28
5. Mar. 23 to Nov. 4
6. Aug. 18 to Oct. 25
7. Apr. 7 to Dec. 3
8. June 23 to Oct. 14

JIM also learned that in some of its work the bank uses **exact interest, which is interest based on a 365-day year instead of the 360-day year** with which you are familiar. The United States government uses exact interest.

In either method, the interest for 1 yr. on \$2500 at 6% is $0.06 \times \$2500$, or \$150, as shown in (1) at the right. In computing the interest for 90 da. by the ordinary 360-day method you then take $\frac{90}{360}$, or $\frac{1}{4}$, of this yearly interest. In computing the exact interest for 90 da., you have to take $\frac{90}{365}$, or $\frac{18}{73}$, of the yearly interest, as shown in (2). This amounts, as shown in (3), to \$36.99 to the nearest cent.

(1) \$2500
$\times 0.06$
\$150.00

(2) $\frac{90}{365} = \frac{18}{73}$

(3) $\frac{18}{73} \times \$150 = \$36.986\cdots$
\$36.99. *Ans.*

In the example above, the 360-day interest for the 90 da. would be $\frac{1}{4}$ of \$150, or \$37.50. **Exact interest is always less than 360-day interest.**

Exact interest is usually found from tables, but such a table is too large to be given here.

Find the exact interest in each of these cases:

1. \$1500, 5%, 90 da.
2. \$2500, 4%, 60 da.
3. \$3600, 6%, 73 da.
4. \$2750, 5%, 146 da.
5. \$7300, 4%, 135 da.
6. \$4800, 6%, 260 da.

7. Using the table on the opposite page to find the exact number of days, find the exact interest at 5% on \$2900 from Apr. 27 to Sept. 20. Then find the 360-day interest for the same number of days.

THE week after he visited the bank, Jim had a little business problem of his own. He needed 50¢ to make his weekly deposit in the Thrift Club to which he belonged. The Rices' neighbor, Mr. Teel, owed Jim 75¢ for cleaning his cellar, but Mr. Teel was away on a business trip and would not get back for 10 da. So Jim borrowed 50¢ from his father. Mr. Rice said that when he borrowed money he had to give a **promissory note** to show that he had borrowed the money and was promising to pay it back. Jim therefore wrote this note:

$0.50 Toledo, Ohio, Feb. 7, 19–

Ten days after date, for value received, I promise to pay to the order of George Rice fifty cents, with interest at 6%.

James Rice

In this case, Jim is the **maker** of the note; his father, George Rice, is the **payee**; the **face** of the note, the amount borrowed, is 50¢; the **time**, or **term**, of the note is 10 da.; the **rate of interest** is 6%; the **date of the note** is Feb. 7; and the **date of maturity**, the date on which the note is to be paid, is 10 da. after Feb. 7, which is Feb. 17.

The words "for value received" show that **the note was given for some consideration**, in this case, the 50¢ borrowed.

Of course, the note was not legal because Jim was not old enough to make a real note, and the interest at 6% on 50¢ for 10 da. was not large enough to count. But Jim learned how business men give notes when they borrow money.

1. Donald Snow, who lives in Trenton, N. J., borrowed $5 from his uncle, Mr. Arthur Snow, in order to buy some wire netting for his chicken yard. Don gave his uncle a promissory note dated June 1 and due in 30 da. with interest at 6%. Write the note, using the same form that Jim Rice used.

2. In Ex. 1, who was the maker of the note? Who was the payee? What was the face of the note?

3. In Ex. 1, what was the date of the note? the term (time) of the note? the date of maturity?

4. In Ex. 1, how much was the interest on the note?

5. Ted's father, Mr. Howard Moore, borrowed $50 from Mr. Richard White. Mr. Moore gave Mr. White a note, dated Nov. 1, and due in 60 da. with interest at 5%. Write the note, using before the date the name of the place in which you live.

6. In Ex. 5, the note was due exactly 60 da. after Nov. 1. How many days are there in November? in December? What was the date of maturity? How much interest was due?

Find the dates and amounts that belong in the blank columns:

	Face of Note	Date of Note	Term of Note	Date of Maturity	Interest Due at 6%
7.	$50	Mar. 1	30 da.		
8.	$75	May 1	60 da.		
9.	$100	June 15	30 da.		
10.	$125	Sept. 5	60 da.		
11.	$200	Oct. 7	90 da.		
12.	$500	July 17	60 da.		

Borrowing at a Bank

MR. RICE told Jim that when he needs to borrow money to use in his business, he borrows it from his bank. He has to give the bank a promissory note, but instead of writing it out the way Jim did the note on page 136, he simply fills in a printed form that the bank furnishes. He filled in one of these forms for $50, as shown below, so that Jim could see it:

$50.00 Toledo, Ohio, Feb. 10, 19—

Thirty days after date, for value received, I promise to pay to the order of The First National Bank Fifty and no/100 Dollars, with interest at 6 %, payable at The First National Bank, Toledo, Ohio.

George Rice

He also told Jim about giving security for notes. He said that one time when he borrowed $2500 he left with the bank some Liberty bonds that were worth more than this amount. If he had not paid the note when it was due, the bank would have sold the bonds. But he did pay the note, and so the bank gave him back his bonds.

---

1. Find the amount of interest that is due on a note for $1250, payable in 90 da. with interest at 6%.

Find the interest due on each of these notes:

2. $1800, 60 da., 5%
3. $2550, 30 da., 4%
4. $15,000, 30 da., 7%
5. $16,250, 90 da., 6%

MR. RICE told Jim that banks sometimes require borrowers to pay interest in advance. He said that when he borrowed the $2500, as mentioned on the opposite page, he made out a 60-day note for this amount, payable to the bank. The rate of interest agreed upon was 6%. The bank deducted the interest, which was $25, and paid the balance of $2475, called **the proceeds of the note**, to Mr. Rice.

At the bank, they called this **"discounting Mr. Rice's note for $2500,"** and spoke of the interest as the **"discount." Bank discount is only another name for interest paid in advance.**

In writing such a note on the printed form shown on the opposite page, the words "with interest at ——%" would be crossed out, because the interest has already been paid.

1. Mr. Cole wishes to borrow $3200 for 30 da. If his bank will discount a 30-day note for this amount at 6%, how much will the discount be? What will the proceeds be?

Find the proceeds of a note in which the face, the time for which discounted, and the rate of discount are as follows:

2. $850, 30 da., 6%
3. $1200, 90 da., 6%
4. $12,500, 6 da., 6%
5. $18,600, 18 da., 6%
6. $6000, 60 da., 5%
7. $12,000, 90 da., 4%
8. $24,800, 30 da., $4\frac{1}{2}$%
9. $12,600, 60 da., $5\frac{1}{2}$%

10. On a 60-day note which was discounted by a bank at 6%, the discount amounted to $6.50. Do you see how to find the face of the note? What was it?

11. A bank discounted a 90-day note for Mr. Cole at 6%. The discount was $18.90. What was the face of the note?

Problems about Notes

1. Write a 30-day note for $250, payable to the order of the First National Bank in the place where you live. Date the note today and do not mention interest. Sign the note "John Doe." If discounted at 6%, what will the proceeds be?

2. On a note for $4500, which was discounted at 6%, the borrower paid a discount of $22.50. What was the time for which the note was discounted?

Find the numbers that belong in the blank spaces:

	Face of Note	Term of Note	Rate of Discount	Amount of Discount	Proceeds of Note
3.	$800	90 da.	6%	$_____	$_____
4.	$_____	30 da.	6%	$6.25	$_____
5.	$1450	90 da.	____%	$21.75	$_____
6.	$1280	__ da.	6%	$_____	$1273.60
7.	$_____	__ da.	5%	$45.75	$3614.25

SPECIAL TIMED PRACTICE

Time: 8 min.

1. $89.86	2. $665.77	3. $528.59	4. $145.33
98.96	456.90	937.70	220.48
+ 88.98	+ 76.58	+ 20.37	+ 235.69
5. $92.90	6. $706.32	7. $48.75	8. $30.08
− 48.33	− 325.67	× 109	× 160

9. Divide $49.12 by 307

10. Divide $470.80 by $8560

MR. RICE told Jim some more things about notes. He said that sometimes it is not possible to tell just how long a business house will want to keep money that has been borrowed. In such cases a **demand note** may be used. Mr. Rice wrote this demand note for $50 to show Jim what he meant:

$50.00 Toledo, Ohio, Feb. 10, 19—

On demand, for value received, I promise to pay to the order of Milton Black

Fifty and no/100 Dollars,

with interest at 6%.

George Rice

Such a note must be paid whenever the payee, who in this case is Milton Black, demands it. Interest at 6% from the date of the note is paid at the same time.

Mr. Rice also told Jim that **notes can be bought and sold** like any other property of value. Suppose, for example, that Mr. Rice makes out a 90-day note for $1200 to Mr. Green. If Mr. Green does not wish to wait 90 da. for the money, he can sell the note to his bank. To do this, he makes the note payable to the bank by indorsing it in the same way as he would a check (page 123). The bank will, of course, charge Mr. Green interest, or discount, for advancing the money before it is due. The bank keeps the note until it is due and then presents it to Mr. Rice for payment.

When Mr. Green indorses the note, he agrees to pay it in case the maker (Mr. Rice) does not. **Never indorse a note unless you are willing to pay it in case the maker does not.**

WHEN Mr. Green sells Mr. Rice's note to the bank, as explained on the previous page, the bank must find the discount and the proceeds. Suppose that the note, which is a 90-day note for $1200, is dated May 1, and bears interest at 6%. The note is due July 30. The amount due on that date is the sum of the face and interest. As shown in the first step at the right, this will be $1218.00.

$1200.00 ← Face of note
+18.00 ← Int. on $1200 for 90 da.
$1218.00 ← Due on July 30

$12.18 ← Int. on $1218 for 60 da.
+1.22 ← Int. on $1218 for 6 da.
$13.40 ← Discount for 66 da.

$1218.00 ← Due on July 30
−13.40 ← Discount
$1204.60 ← Proceeds on May 25

Suppose now that Mr. Green has held the note until May 25 before selling it to the bank. The bank first finds from a table that from May 25 to July 30 there are 66 da. The discount on $1218 for 66 da., as computed by the six-per-cent method in the second step above, is $13.40.

The proceeds, as shown in the third step, are $1204.60. The bank pays this to Mr. Green on May 25, and on July 30 receives from Mr. Rice the $1218.00 that is due on that date.

If a note bears interest, the discount is computed on the sum of the face and the interest due at maturity.

You will not often have to solve problems like this. Under ordinary conditions, Mr. Rice would borrow the $1200 directly from his own bank. The principle of discounting an obligation that is due at some future date is, however, frequently found in business, and you should know what it means.

1. Write a demand note for $450, payable to some bank, and sign it "John Doe." Date the note today and have it bear interest at 6%. If payment is demanded in 12 da., what will be the sum of the face and interest?

2. A business man borrowed $18,600 on a demand note bearing interest at $5\frac{1}{2}$%. The loan was "called," which means that payment was demanded, 30 da. after the date of the note. How much did he pay, including the face and interest?

3. Mr. Cole borrows $800 from his friend, Mr. Snow, and gives him a 60-day note bearing interest at 6%. What will be the sum of the face and interest on the date of maturity?

4. In Ex. 3, suppose that Mr. Snow needs the money and sells the note to his bank 30 da. before it is due. At 6%, what will the discount be? What will the proceeds be?

5. Mr. Rogers has a 6-months' note for $1400 that bears interest at 5%. If he discounts the note at 6% at his bank 96 da. before it is due, how much will he receive as proceeds?

6. Mr. Barrows has a 90-day note for $1650, which is dated Aug. 1 and bears interest at 6%. If he discounts the note at his bank on Aug. 19 at 6%, what will the proceeds be?

Find the proceeds in each of the following cases:

	Face of Note	Date of Note	Term of Note	Rate of Interest	Date of Discount	Rate of Discount
7.	$850	Mar. 1	30 da.	6%	Mar. 7	6%
8.	$1800	Nov. 1	90 da.	5%	Nov. 19	6%
9.	$2000	Sept. 15	60 da.	6%	Oct. 15	6%
10.	$3600	Aug. 7	90 da.	5%	Aug. 31	6%

WHEN you learned about **buying on the installment plan** on page 42, you found that things often cost more when bought this way than when paying cash.

For example, suppose that an automobile which sells at $1200, cash price, is offered at $300 down, with the balance of $900 to be paid in monthly installments for 1 yr. If the purchaser had to borrow $900 at 6% for 1 yr., the interest would be $54. It therefore seems fair for the company that is selling the car to add this to the $900 and then divide the sum, which is $954, by 12 to find the amount of each monthly payment. This makes monthly payments of $79.50 each, of which $75 is paid on the principal ($900) and $4.50 is interest.

But in paying $75 each month on the principal, the purchaser, instead of borrowing $900 for 1 yr., is actually borrowing $75 for 1 mo., $75 for 2 mo., and so on to the last payment for which he borrows $75 for 12 mo. If you add the numbers 1, 2, 3, . . ., 12, the sum is 78. In other words, the purchaser is actually borrowing $75 for 78 mo.

At 6%, the monthly interest on $75 is 0.37\frac{1}{2}$, and so the interest for 78 mo. would be $29.25 instead of the $54 that the purchaser actually pays. He therefore pays interest at more than 6%; in fact, it is about 11% (see Ex. 1, page 145).

Before buying anything on the installment plan, see what actual rate of interest you will have to pay.

The company that sells the car is justified in charging more than 6% on account of the greater risk and the extra bookkeeping involved in twelve payments instead of one. This case, however, shows that what looks like interest at 6% is actually much more, and in many installment purchases the actual rate of interest is even higher than here.

1. On the opposite page the actual rate of interest is given as about 11%. To how many years and a fraction is 78 mo. equal? How do you find the rate when you know the principal, time, and amount of interest? Check the 11% by finding the rate when $54 is charged for borrowing $75 for 78 mo.

2. Mrs. Fry is buying a set of dining-room furniture. The cash price is $150, or she can buy it by paying $30 down and $20.75 per month for 6 mo. How much more does the set cost on the installment plan than by paying cash?

3. In Ex. 2, how much would Mrs. Fry have to pay in interest if she borrowed $120 for 6 mo. at 6%?

4. In Ex. 2, $20 of the monthly payment may be considered as paid on the principal. What is the sum of the numbers 1 to 6? Paying off $20 per month on $120 is equivalent to borrowing $20 for how many months? for how many years?

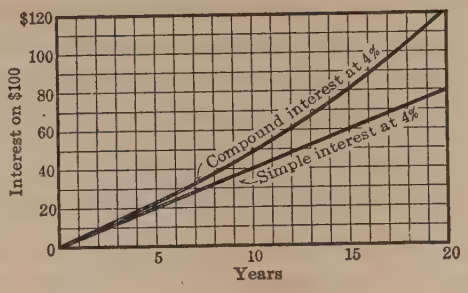
5. In Ex. 4, how much interest will Mrs. Fry actually pay? Find, to the nearest 0.1%, the actual rate of interest that she will pay in buying the set on the installment plan.

Find the actual rate of interest paid in each case:

	Article	Cash Price	Paid Down	No. of Monthly Payments	Monthly Principal Payment	Monthly Interest Payment
6.	Gas stove	$100	$20	8	$10	50¢
7.	Radio set	$105	$15	6	$15	50¢
8.	Vacuum cleaner .	$55	$5	8	$6.25	25¢
9.	Washing machine	$175	$25	12	$12.50	$1.00
10.	Automobile . . .	$1120	$400	12	$60	$3.60

IN a savings bank, as you already know, you can have the interest, as it comes due, added to your account. Interest for the next period will be computed on this new balance. In this way, **savings accounts pay compound interest.**

This graph shows the difference between simple interest and compound interest at 4%. The interest in each case is computed on a principal of $100, and the compound interest is assumed to be compounded semiannually (added to the principal every 6 mo.).



1. Estimating the amounts as closely as you can, find from the above graph the difference between simple and compound interest at 4% at the end of 10 yr.; of 15 yr.; of 20 yr.

2. At simple interest at 4%, it takes 25 yr. for $100 to double itself, and at 4%, compounded semiannually, it takes only 17.5 yr. The time at compound interest at 4% is what per cent less than at simple interest at 4%?

3. At 6% instead of 4%, the time in Ex. 2 would be 16.7 yr. and 11.7 yr. respectively. The time at compound interest at 6% is what per cent less than at simple interest at 6%?

4. By promptly reinvesting simple interest, an investor can receive compound interest. Mr. Ware is investing $1000 at 6%, with the interest payable every 6 mo. How much interest will he get at the end of 6 mo.? If he reinvests this at 6%, how much interest will he get at the end of the next 6 mo.?

COMPOUND interest is frequently found from tables. Here is a small table showing the sum of principal and interest, called the **compound amount**, on \$100 at 2%, 3%, 4%, 5%, and 6%, compounded semiannually. In actual work, tables with a larger number of decimal places are used, but this table, even though it gives only approximate results in cases like Ex. 4 below, shows how the larger tables are used.

TIME	2%	3%	4%	5%	6%
$\frac{1}{2}$ yr.	\$101.00	\$101.50	\$102.00	\$102.50	\$103.00
1 yr.	102.01	103.02	104.04	105.06	106.09
$1\frac{1}{2}$ yr.	103.03	104.57	106.12	107.69	109.27
2 yr.	104.06	106.14	108.24	110.38	112.55
$2\frac{1}{2}$ yr.	105.10	107.73	110.41	113.14	115.93
3 yr.	106.15	109.34	112.62	115.97	119.41
$3\frac{1}{2}$ yr.	107.21	110.98	114.87	118.87	122.99
4 yr.	108.28	112.65	117.17	121.84	126.68
$4\frac{1}{2}$ yr.	109.36	114.34	119.51	124.89	130.48
5 yr.	110.45	116.05	121.90	128.01	134.39

1. From the table, find to how much \$100 will amount at 5%, compounded semiannually, in 2 yr.; in 4 yr.; in 4 yr. 6 mo.

2. At 6%, compounded semiannually, \$100 will amount to \$119.41 in 3 yr. How much of this is interest?

3. At 4%, compounded semiannually, find the interest on \$100 for 2 yr.; for 3 yr. 6 mo.; for 4 yr. 6 mo.

4. At 4%, compounded semiannually, \$100 will amount to \$112.62 in 3 yr. A principal of \$1000 would amount to 10 times as much. To how much would \$2000 amount?

5. At 5%, compounded semiannually, to how much will \$450 amount in 2 yr.? in 3 yr. 6 mo? in 5 yr.?

1. In building up a savings account, **the most important thing is to save regularly, even if it is only a small amount.** Many banks have Thrift Clubs in which the members deposit each week for 50 wk. a fixed amount, such as 50¢, \$1, \$2, or \$5. In one club, each member receives at the end of the 50 wk. a check for his deposits plus interest that is equal to $1\frac{1}{2}\%$ on the total deposited. How much will a member who deposits \$5 a week receive?

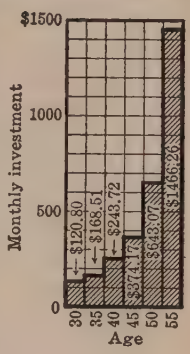
2. In Ex. 1, find how much will be received by a club member who deposits \$1 per week; \$2 per week; \$10 per week.

3. In an ordinary savings account, with interest compounded semiannually at 4% a year, regular deposits of \$5 per month will amount to \$332.32 in 5 yr. What is the total amount deposited? How much interest is earned during the 5 yr.?

4. At $4\frac{1}{2}\%$, compounded semiannually, regular monthly deposits of \$5 will amount to \$336.63 in 5 yr. How much of this is interest? The interest is how much more than in Ex. 3?

5. You can save \$1000 in 5 yr. by depositing \$3.40 per week for 52 wk. each year in a savings bank which pays $4\frac{1}{2}\%$ a year, compounded semiannually. What will be the total amount deposited? How much of the \$1000 will be interest?

6. This graph shows the advantage of **starting to save just as early as you can.** Suppose, for example, that you would like to have \$100,000 when you are 60 yr. old. If you start when you are 30 and invest your money at 5% a year, reinvesting the interest as it is paid, you will have to invest \$120.80 per month in order to have the \$100,000. During the 30 yr., how much will you have to invest? How much of the \$100,000 will be interest? Which is greater, the interest or the amount invested? How much greater is it?



7. In Ex. 6, if you wait until you are 50, you will have to invest \$643.07 per month. During the 10 yr., how much will you have to invest? How much will the interest be? Which is greater, and how much, the interest or the amount invested?

8. Different savings banks have different rules about paying interest on deposits. At Mr. Coe's bank, interest at 4% a year is paid on Jan. 1 and July 1 on the smallest balance, **disregarding the cents,** on deposit during the previous 6 mo. On July 1 a man deposited \$500. If he makes no other deposits and no withdrawals, what will be the balance of his account on the next Jan. 1? the next July 1? the next Jan. 1?

9. At another bank, interest at 4% a year is paid on Jan. 1 and July 1, and the interest, **disregarding cents in the principal,** is computed from the first of the month following a deposit. On July 1, Mrs. West's account showed that interest was due on \$655.40 for 6 mo., on \$20 for 5 mo., on \$12.50 for 3 mo., and on \$27.08 for 1 mo. How much interest was due her? What was her balance after adding the interest?

See if you can do all these additions correctly:

1.	2.	3.	4.	5.
251	259	623	571	$9.53
304	844	167	883	1.06
932	578	145	94	8.41
429	857	492	635	9.12
273	735	879	878	7.03
468	689	357	44	.86
946	968	768	329	2.59

See if you can do all these subtractions correctly:

6.	7.	8.	9.	10.
9327	8145	8673	9415	$92.40
5869	4767	698	2789	78.97

11.	12.	13.	14.	15.
6373	8951	7356	7235	$71.54
3985	3874	6597	978	29.86

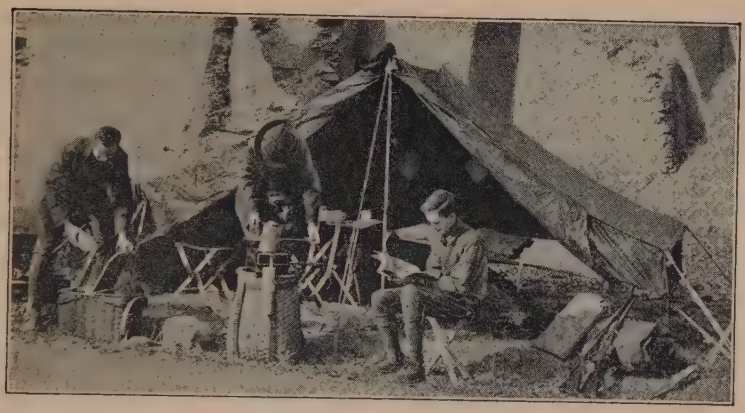
Multiply, and then check by going over your work:

16.	17.	18.	19.	20.
628	964	748	839	546
72	38	95	64	47

21.	22.	23.	24.	25.
325	645	978	523	679
85	62	49	93	96

Copy, divide, and then check by multiplication:

26. $48\overline{)24{,}384}$	30. $92\overline{)79{,}948}$	34. $37\overline{)22{,}089}$
27. $73\overline{)47{,}304}$	31. $54\overline{)36{,}990}$	35. $85\overline{)84{,}745}$
28. $59\overline{)26{,}963}$	32. $69\overline{)65{,}343}$	36. $86\overline{)56{,}588}$
29. $72\overline{)53{,}640}$	33. $78\overline{)27{,}768}$	37. $97\overline{)58{,}685}$



Camping and Corporations

DID you ever go camping? It is a lot of fun. Last summer five boys wanted to go camping for two weeks, but they found that it was going to cost about $100 to buy a tent, cots, blankets, camp stools, cooking utensils, and the other things they would need.

The boys did not have as much as $100, but they thought that if they could get it, they could buy the outfit, use it themselves, and then rent it to other boys who wanted to go camping. In this way they could perhaps make some money.

Jack's father said that in such a case **business men would form a corporation.** They would call the $100 the **capital** needed to carry on the business, and to get it they would issue and sell $100 worth of **stock**, divided into units called **shares**, to anyone who cared to buy it. The boys had a meeting and decided to do this. They called their business the "Campers' Renting Company," and planned to sell 100 shares of stock, each with a value of $1.

THE boys had no trouble in selling the stock of the "Campers' Renting Company." Jack bought 10 shares, Fred bought 10, Arthur bought 7, Ned bought 6, and Tom bought 3. Their fathers bought the rest of the stock.

Of course, the boys did not really form a corporation the way business men do, because **corporations have to be formed in accordance with the laws of the various states.** But the general plan in each case is the same.

After the boys sold their stock, they bought the camping outfit and were ready to start business. The boys managed the business themselves, and Jack's father helped them so that it was run just the way a real corporation would be run.

---

1. Jack's 10 shares cost him \$10. How much money did each of the other boys put into the business?

2. When they bought the rest of the stock, how much money did the fathers of the boys put into the business?

3. A group of men are planning to start a company to manufacture and sell a new kind of windshield wiper for automobiles. They will need \$75,000 in capital to start the business. If they raise this money by selling stock, how many shares, each valued at \$100, will they have to sell?

4. Mr. Grimes bought 40 shares of stock in the company in Ex. 3. At \$100 per share, how much did it cost him?

5. At \$100 per share, how many shares of stock is it necessary to sell in order to secure a capital of \$100,000? of \$500,000? of \$2,500,000?

6. In raising a capital of \$750,000, a new corporation sold 7500 shares of stock. What was the value of each share?

THE boys decided that they would charge \$10 a week for the rent of the camping outfit. If they are to **make a profit** like any other business, they will have to receive as rent **more than the expenses of doing business.**

Anyone who buys stock in a corporation is called a **stockholder.** The **stockholders of a corporation are its owners,** and as such they receive **a share in any profit** that is made.

---

1. The boys charged themselves \$10 a week for the rent of the camping outfit for the 2 wk. that they used it. How much did each of the 5 boys have to pay?

2. They rented the outfit for 6 wk. to other boys. How much, including the rent in Ex. 1, did they receive in all?

3. During the season, the boys paid \$10 for repairing some of the cots and stools that were broken and \$40 for other expenses. How much was left of the money received as rent?

4. Jack's father advised the boys to put \$10 in the bank to pay for repairs next year, or for other emergencies. How much did this leave from the money received as rent?

5. The money left after deducting the expenses in Exs. 3 and 4 represented the company's profit on the summer's business. They decided to divide this profit among the stockholders. How much could they pay on each of the 100 shares of stock?

6. Jack owned 10 shares and Arthur owned 7 shares. How much did each of these boys receive as profit?

7. One year the sales of a small manufacturing company amounted to \$186,400. The expenses that year were \$171,488. If none of the profit was reserved for emergencies, how much could the company pay to its stockholders?

WHEN a corporation distributes its profit among the stockholders, it is said to be paying a dividend. **The amount of dividend paid depends upon the amount of profit.**

Dividends are usually paid as a **certain per cent of the value at which each share is issued, or as a certain amount per share.** The "Campers' Renting Company" made a profit of $20 on the first summer's business. The company could pay a dividend of 20¢ on each of the 100 shares, or of 20% on the value, $1, at which each share was issued.

---

1. Jack's father owned 15 shares of the stock of the "Campers' Renting Company." When the company paid a dividend of 20% on its stock, how much did he receive?

2. Ned's father owned 12 shares of the stock of the "Campers' Renting Company." How much did he receive?

3. Ned's father also owned 10 shares of stock, each issued at $100, in a small manufacturing company. Last year this company paid dividends of 7%. How much money did Ned's father receive from this stock?

4. At the end of the first 6 mo. last year, an automobile company paid its stockholders a dividend of $2.75 per share. How much did the owner of 75 shares receive at that time?

5. A company paid a dividend on its stock of $1\frac{3}{4}$% for the first quarter (3 mo.) of this year. If the same dividend rate is maintained for the rest of the year, what will be the total rate for the year?

6. A company with a capital of $500,000 paid its stockholders $32,500 in dividends last year. What per cent of dividends did the company pay for the year?

MANY people invest their savings by buying the stocks of various corporations. Manufacturing companies, railroads, electric-light companies, and other public-service corporations offer many opportunities for investments. The corporations use the investors' money to carry on their business and pay the investors an income in the form of dividends.

The value at which a share of stock is issued is called the par value. Many stocks are issued at a par value of $100 per share. Dividends are always computed on the par value.

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1. When a company in which the stock has a par value of $100 per share is paying dividends of 6% a year, how much will the owner of 25 shares receive?

2. When a corporation is paying big dividends, investors often have to pay more than the par value for its stock. If Mr. Reed had to pay $150 a share for stock that has a par value of $100, how much more than the total par value did he pay for 40 shares?

3. In Ex. 2, the company paid dividends of 9% last year, which were, of course, computed on the par value. How much income did Mr. Reed get from his 40 shares?

4. If a corporation's dividend rate is low, or it fails to pay dividends, its stock will often be worth less than the par value. Mr. Reed paid $80 a share for 60 shares of stock of par value $100. He hoped that the company would soon make money and pay bigger dividends. How much less than the total par value did he pay for the stock?

5. In Ex. 4, the company paid dividends of 4% the next year. How much income did Mr. Reed get from his 60 shares?

1. At \$100 a share, how many shares of stock must a corporation sell in order to secure a capital of \$650,000?

2. Mr. Ray bought 80 shares of stock in a new company that was being formed. At the par value, which was \$100 a share, how much did the stock cost him?

3. In Ex. 2, how much will Mr. Ray receive when the company pays a dividend of $3\frac{1}{2}\%$ on its stock?

4. Mrs. Moorehouse bought 5 shares of stock, of par value \$100. The stock cost her \$120 per share. How much more than the total par value did she pay for it?

5. In Ex. 4, the stock paid dividends of 8% the first year. How much income did she receive?

6. A company that has a capital of \$1,250,000 is planning to pay \$31,250 to its stockholders as a dividend for 6 mo. What per cent of dividend will it pay?

See how quickly you can do these multiplications:

7. \$110 × 40	8. \$86 × 75	9. \$162.50 × 50	10. \$98.75 × 30
11. \$160 × 80	12. \$92 × 65	13. \$116.25 × 150	14. \$87.50 × 140

Find these per cents:

15. 6% of \$1500
16. $5\frac{1}{2}\%$ of \$1800
17. $6\frac{1}{2}\%$ of \$2600
18. $1\frac{3}{4}\%$ of \$8000
19. $2\frac{1}{2}\%$ of \$18,500
20. $1\frac{3}{4}\%$ of \$32,800
21. $3\frac{1}{4}\%$ of \$65,000
22. $2\frac{3}{4}\%$ of \$128,500

Meaning of Insurance

THE careful investor **would not make an investment in which he knows his money will not be safe.** The house in which you live, whether owned by your parents or by the landlord, represents an investment of money.

If the house should burn to the ground, the money invested in it would be lost. It might easily take years for the ordinary family to save enough money to replace such a loss.

The careful man protects himself against the loss of money invested in property by buying insurance.

There are companies that make a business of insuring property against loss by fire. The owner of the property pays a certain amount to the company, and the company agrees, in case of a fire, to pay the owner the amount of his loss. Such insurance is called **fire insurance.**

MR. LEE'S house is insured against loss or damage by fire for an amount not exceeding $8000. When he insured it, Mr. Lee paid the insurance company a certain amount, called the **premium**. The company gave him a **policy** which described all the conditions under which the insurance was issued. The $8000, which is paid only in case of a total loss, is called the **face of the policy**.

Fire-insurance rates, from which the premium is determined, are stated as so much **for each $100 of insurance for 1 yr.**

$$\text{Yearly premium} = \tfrac{1}{100} \text{ of face} \times \text{rate.}$$

In insuring his house for 1 yr. for $8000 at a rate of 22¢, Mr. Lee would have to pay a premium of $17.60, as shown at the right.

$0.22 ← Rate per $100
80 ← $\frac{1}{100}$ of face
$17.60 ← Yearly premium

The rates vary according to the type of property and to the risk of fire. Below are the rates in one city for insuring several types of property:

Type of Property	Yearly Rate
One-family house, wooden roof	25¢
One-family house, non-combustible roof	23¢
Three-family house, wooden roof	48¢
Three-family house, non-combustible roof	45¢
Private 2-car garage, non-combustible roof	23¢
Public garage, steel and concrete	65¢
Office building, steel and concrete	$10\frac{1}{2}$¢
Varnish factory, brick with wood floors	$1.70

In recent years the losses from fire in the United States have frequently been about $550,000,000 a year, which is more than $1,500,000 a day, or more than $1000 every minute.

1. Mr. Cate wishes to insure his house for $6000. At a rate of 18¢, how much will the premium be for 1 yr.?

2. Mr. West insured his house for 1 yr. for $12,000. The rate was 24¢. How much was the premium?

3. Fire-insurance policies are often written for periods longer than 1 yr. The premium for 2 yr. is $1\frac{3}{4}$ times the yearly premium, for 3 yr. it is $2\frac{1}{2}$ times the yearly premium, and for 5 yr. it is 4 times the yearly premium. In Ex. 2, how much would the premium have been if Mr. West had insured his house for a period of 2 yr.? of 3 yr.? of 5 yr.?

4. Mr. Gray insured his house for $7500 for a period of 3 yr. The yearly rate on this type of property was 20¢. How much was the premium for the 3 yr.?

5. A factory building was insured for $68,000 for a period of 5 yr. The yearly rate was 80¢. How much was the premium on the 5-year policy?

Using the rates in the table on page 158, find the amount of premium paid for insuring these pieces of property:

	Property Insured	Face of Policy	Period
6.	1-family house, wooden roof . .	$8500	3 yr.
7.	Private 2-car garage	$800	5 yr.
8.	Office building	$400,000	3 yr.
9.	Public garage	$50,000	2 yr.
10.	3-family house, non-combustible roof	$14,000	3 yr.
11.	1-family house, non-combustible roof	$28,000	5 yr.

WHEN June Lee told her father about studying fire-insurance problems in school, he told her that it cost him \$17.60 to insure their house for \$8000 for 1 yr. To find the rate, he told June first to write

$$\text{Yearly premium} = \tfrac{1}{100} \text{ of face} \times \text{rate};$$

then $\$17.60 = \frac{1}{100}$ of $8000 \times$ rate,

or $\$17.60 = 80 \times$ rate.

$$80\overline{)\$17.60}$$
$$\$0.22$$

At this point, June said: "I know how to find the rate now. You divide \$17.60 by 80." So June divided as shown above, and found that the rate was 22¢ (per \$100).

$$\text{Rate} = \frac{\text{yearly premium}}{\frac{1}{100} \text{ of face}}.$$

June's father also showed her how to find the face of a policy when given the rate and the yearly premium.

Since Yearly premium $= \frac{1}{100}$ of face $\times$ rate,

then $$\tfrac{1}{100} \text{ of face} = \frac{\text{yearly premium}}{\text{rate}},$$

or $$\text{Face} = \frac{100 \times \text{yearly premium}}{\text{rate}}.$$

Thus, when it costs \$17.60 to insure a house for 1 yr. at a rate of 22¢, June can first write

$$\text{Face} = \frac{100 \times \$17.60}{0.22}.$$

She can then divide, as shown at the right, and find that the face is \$8000.

$$0.22\overline{)\$1760.00}$$
$$\$80\ 00.$$

Mr. Lee said that the face is always stated in a policy, and so people rarely have to solve a problem like this, but June was interested to see that she could do it.

1. It cost the owner of an apartment house \$195 to insure the building for \$75,000 for 1 yr. What was the rate (per \$100) at which the insurance was issued?

2. When Mr. Coleman insures his house for \$12,500 for a period of 3 yr., he pays a premium of \$75. The premium for the 3 yr. is $2\frac{1}{2}$ times the yearly premium. What would the yearly premium be? What is the yearly rate?

3. The premium on a 5-year policy for \$8500 is \$102, and the 5-year premium is 4 times the yearly premium. What would the yearly premium be? What is the yearly rate?

4. It costs Mr. Harris \$21.32 to insure his house for 1 yr. The rate is 26¢. What is the face of the policy?

5. Property is often insured for less than its full value. Mr. Dean's house is valued at \$15,000. If he insures it for 80% of this value for a period of 3 yr. (see Ex. 2), how large a premium will he have to pay at a yearly rate of 32¢?

6. A factory building valued at \$120,000 was insured for 80% of its value for a period of 5 yr. (see Ex. 3). At a yearly rate of 72¢, how much was the 5-year premium?

Find the numbers that belong in the blank spaces:

	Value of Property	Per Cent Covered	Face of Policy	Yearly Rate	3-Year Premium
7.	\$12,000	80%	\$_____	24¢	\$_____
8.	\$_____	80%	\$4000	20¢	\$_____
9.	\$10,000	____%	\$8000	____¢	\$48.00
10.	\$_____	90%	\$_____	30¢	\$67.50
11.	\$18,000	75%	\$_____	28¢	\$_____

THERE are many other kinds of insurance besides fire insurance. The general principle is the same in all. The insurance company collects a small premium from each of many individuals, and the few who suffer loss are paid from the money that is collected from all. Here is a partial list of different kinds of insurance:

1. Life
2. Health
3. Accident
4. Automobile
5. Employer's liability
6. Theft
7. Tornado
8. Marine
9. Rain
10. Income

---

1. The Jenkins family lives in a state where they have occasional tornados. Their house is insured for $6500 against loss or damage by a tornado. If the rate is 45¢ per $100 for 1 yr., how much is the yearly premium?

2. Mr. Lee carries a theft-insurance policy for $2000 to provide against loss of household goods by theft. It costs him $24.80 per year. What is the rate per $1000?

3. A ship was insured for $500,000 against loss by fire or by perils of the sea for a period of 1 yr. The rate was $3.25 per $100. How much was the premium?

4. In Ex. 3, part of the ship's cargo on one trip was insured for $28,000 against loss at sea. The rate was $12\frac{1}{2}$¢ per $100. How much was the premium?

5. The promoters of an airplane meet took out $2500 worth of insurance against loss of gate receipts if it should happen to rain on the day of the meet. At $8.40 per $100, how much was the premium?

1. To protect himself, Mr. Lee insures his automobile against loss or damage by fire and against loss by theft. The fire insurance costs him \$6.40 per year, and the theft insurance costs \$10.20. How much does he pay per year for both?

2. Mr. Lee also pays \$42.50 per year for a personal-injury policy providing payments up to \$20,000 to people his car might accidentally injure, and \$16.40 per year for a policy providing payments up to \$1000 for damage his car might do to other people's property. Including the amount found in Ex. 1, how much is Mr. Lee's yearly insurance bill on his car?

3. In Ex. 2, how much, to the nearest cent, does Mr. Lee pay per month for insurance on his car?

4. Find, to the nearest 0.1¢, the cost per mile for insurance in a year in which Mr. Lee drives 12,500 mi.

MR. LEE also has $20,000 worth of **life insurance.** If he should die, the insurance company would pay $20,000, the **face of the policy,** to Mrs. Lee, who is called the **beneficiary.** Mrs. Lee and June would have this money to help support themselves when Mr. Lee's income stops at his death.

Life-insurance rates are stated at so much **per year for each $1000 of insurance.** They vary according to the age of the person insured and to the kind of policy, as shown below:

Age of Insured	Ordinary Life	20-Payment Life	30-Year Endowment	5-Year Term
25	$18.80	$27.24	$29.53	$11.09
30	21.49	29.95	30.51	11.65
35	24.89	33.32	32.09	12.50
40	29.38	37.53	34.64	13.87

In an **ordinary life policy,** the person insured pays premiums each year during his lifetime, and the face of the policy is paid only at his death.

A **20-payment life policy** is like an ordinary life policy, except that premiums are paid only for 20 yr., after which the policy is said to be **paid up.** If the person insured dies within the 20 yr., the premium payments cease and the face is paid to the beneficiary.

In a **30-year endowment policy,** premiums are paid for 30 yr., and at the end of that time the face is paid **to the person insured.** If he dies within the 30 yr., the premium payments cease and the face is paid to the beneficiary.

In a **5-year term policy,** the person insured agrees to pay premiums for 5 yr. If he dies within the 5 yr., the premium payments cease and the face is paid to the beneficiary. If he lives more than the 5 yr., the policy simply expires.

In Exs. 1–12 below, use the table of rates on page 164:

1. Mr. Lee's policy is a 20-payment life policy for $20,000. He took out the policy when he was 30 yr. old. How much is the yearly premium?

2. In Ex. 1, how much less per year would it have cost Mr. Lee if he had taken out the policy when he was 25 yr. old?

3. How much less per year does it cost to take out a 30-year endowment policy for $5000 at age 25 instead of ~~35~~?

4. At age 30, Mr. Reed took out an ordinary life policy, payable to his wife, for $12,000. He died just before the eighth yearly premium was due. How much more than the total premiums paid did Mrs. Reed receive?

5. Mr. Locke took out a 30-year endowment policy for $15,000 at age 30. How much will he receive at age 60? What will be the total amount of premiums paid?

Find the amounts that belong in the blank columns, assuming that death occurs for the ordinary life policies at age 70:

	Type of Policy	Face of Policy	Age at Taking	Yearly Premium	Total Paid in Premiums
6.	20-payment life .	$8000	25		
7.	30-year endowment	$7000	30		
8.	Ordinary life . . .	$10,000	30		
9.	30-year endowment	$15,000	40		
10.	20-payment life .	$12,000	30		
11.	5-year term . . .	$15,000	30		
12.	Ordinary life . . .	$25,000	35		

1. Mr. Lee pays $37.50 per year, in advance, for a health-insurance policy which provides weekly payments of $25 in case he is ill. Last year he was ill for 8 wk. How much more than the yearly premium did he receive?

2. Another health-insurance policy, which costs $56 per year, provides for payments of $25 per week in case of illness for not more than 104 wk. What is the greatest amount that the insurance company might have to pay on such a policy? This amount is how many times the yearly premium?

3. Mr. Lee also has an accident policy which would pay Mrs. Lee $10,000 in case he should be killed in an accident. The policy costs him $49.50 per year, in advance. He has had the policy 10 yr., and never has had an accident. If next year he should be killed in an accident, how much more than the total premiums paid would Mrs. Lee receive?

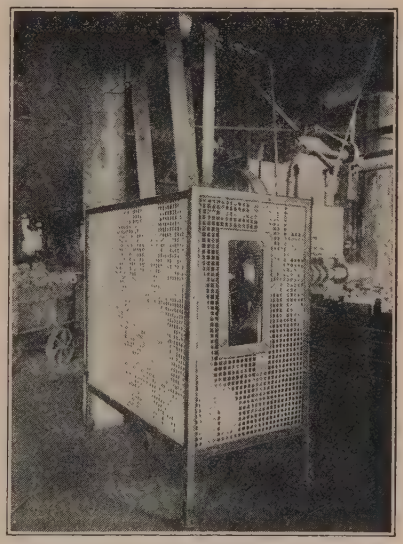
4. The policy in Ex. 3 also provides payments of $50 per week in case he is totally disabled by an accident. If he should be totally disabled for a period of 13 wk., how much more than the yearly premium would he receive?

5. How much per year does Mr. Lee pay for his health and accident insurance (see Exs. 1 and 3)? If he should invest this amount each year at 6%, simple interest, what would be the sum of the payments and interest at the end of 10 yr.?

6. Last year Mr. Brent received $50 per week for 20 wk. while totally disabled by an accident, and $25 per week for 6 wk. of "partial disability" after he was able to go out but could not work full time. How much did he receive in all?

7. In Ex. 6, how much money would Mr. Brent have to invest at 5% in order to receive as income for 6 mo. (26 wk.) as much as he received from the insurance company?

THE laws of many states provide that employers in certain industries **shall pay compensation to workers who receive injury or are killed** during the course of employment. Such payments are usually made by an insurance company from which the employer purchases **liability insurance.**



1. One year a large manufacturing company spent $16,250 in putting safety guards, like the one here shown, around dangerous machines. The company also spent $114,865.20 for insurance premiums. How much was spent in all for the protection of workers?

2. The rates for employer's liability insurance are usually stated as so much **per $100 of the employer's pay roll.** In one case the rate for carpenters is $3.77 per $100, and the rate for men who erect the steel framework of a building is $14.93 per $100. The rate for carpenters is what per cent of that for the steel workers? Why should the rates differ so?

3. A premium of $2553.39, charged on a contractor's pay roll totaling $30,300, is what per cent of the pay roll?

4. An insurance company paid an injured workman $16 per week for 39 wk. and $387.50 for doctors' and hospital bills. What was the total amount that the company paid?

1. At a yearly rate of 22¢ per $100, how much will it cost to insure a house against loss or damage by fire for 1 yr. for $10,500?

2. Mr. Dunn insured his car for $1600 against loss or damage by fire for 1 yr. The rate was 36¢ per $100. How much was the premium on the policy?

3. The fire-insurance rate on Mr. Cole's house is 18¢. A 3-year policy costs $2\frac{1}{2}$ times as much as a 1-year policy. How much will a 3-year policy for $14,000 cost?

4. Mr. Dana took out a 20-payment life policy for $14,000. The yearly rate was $29.95 per $1000. What will be the total premiums paid in the 20 yr.?

5. A life-insurance agent received 30% of the first year's premium as his commission. How much commission did he earn in selling a policy for $20,000 on which the yearly rate was $32.09 per $1000?

See how quickly you can do these multiplications:

6. $1.15 × 80	7. $0.56 × 75	8. $1.54 × 65	9. $0.38 × 750
10. $29.30 × 12	11. $17.85 × 25	12. $31.08 × 32	13. $28.72 × 65

Divide, and then check by multiplication:

14. 75)$16.50	17. 245)$627.20	20. 0.36)$30.60
15. 84)$31.92	18. 685)$787.75	21. 1.28)$134.40
16. 96)$53.76	19. 755)$1162.70	22. 1.54)$223.30

Review of Measures

Find the numbers that belong in the blank spaces:

1. $3\frac{1}{2}$ yd. = ——— ft. = ——— in.
2. 1 rd. = ——— ft. = ——— yd.
3. 1.5 T. = ——— lb. = ——— oz.
4. 40 pt. = ——— qt. = ——— gal.
5. $\frac{3}{4}$ hr. = ——— min. = ——— sec.
6. 25 sq. yd. = ——— sq. ft. = ——— sq. in.
7. 2 bu. = ——— pk. = ——— qt. = ——— pt.
8. $2\frac{1}{7}$ wk. = ——— da. = ——— hr. = ——— min.
9. 24.5 mi. = ——— rd. = ——— ft. = ——— yd.

Write the numbers 10 to 18 on your paper and after each write the equivalent that is nearest the given measure:

	Measure	Equivalent			
10.	25 ft.	3 yd.	9 yd.	6 yd.	8 yd.
11.	$2\frac{1}{2}$ yd.	50 in.	92 in.	75 in.	25 in.
12.	46 in.	3 ft.	6 ft.	4 ft.	$3\frac{1}{2}$ ft.
13.	28 oz.	1 lb.	2 lb.	$1\frac{1}{2}$ lb.	$1\frac{7}{8}$ lb.
14.	$3\frac{1}{2}$ lb.	55 oz.	35 oz.	70 oz.	3.5 oz.
15.	7 bu.	56 pk.	70 pk.	30 pk.	$1\frac{3}{4}$ pk.
16.	8 gal.	16 qt.	32 qt.	40 qt.	64 qt.
17.	$\frac{1}{2}$ mi.	5280 ft.	500 ft.	9000 ft.	2600 ft.
18.	$4\frac{1}{2}$ T.	5000 lb.	450 lb.	9000 lb.	2000 lb.

Read and complete these statements about fractions:

1. In a fraction, the number above the line is called the ——, and the number below the line is called the ——.

2. In "$\frac{7}{8}$ of an orange," the 7 indicates that —— of the —— equal parts of the orange are being considered.

3. A fraction indicates a division in which the dividend is the —— and the divisor is the ——.

4. The terms of the fraction $\frac{2}{3}$ are —— and ——.

5. In an answer, all fractions should ordinarily be reduced to —— terms. The answer $2\frac{3}{6}$ should be reduced to ——.

6. In a proper fraction, the denominator is always —— than the ——.

7. A mixed number is the sum of a whole —— and a ——.

8. Two or more fractions which have the same denominator are said to have a —— denominator.

9. The value of a fraction is greater than 1 when the denominator is —— than the ——.

10. A fraction in which the numerator is equal to or greater than the denominator is called an —— fraction.

11. The decimal 0.25 is equal to the fraction ——.

12. The least common denominator of $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{5}{6}$ is ——.

13. Expressed as a fraction with the denominator 100, the number 7% is ——.

14. The number $25\frac{1}{2}$ is a —— number, $\frac{3}{4}$ is a —— fraction, and $\frac{8}{5}$ is an —— fraction.

15. The fraction $\frac{4}{5}$ is equal to the decimal ——.

16. The simplest form for $33\frac{1}{3}\%$ is the fraction ——.

Write the numbers 1 to 8 on your paper, and after each write the letter indicating the expression in the parentheses that you think is best for completing the statement:

1. Multiplying the numerator of a fraction by a number (*a.* divides the fraction by this number. *b.* multiplies the fraction by this number. *c.* decreases the value of the fraction. *d.* leaves the value unchanged).

2. Dividing the numerator by a number (*a.* multiplies the fraction by this number. *b.* increases the value. *c.* divides the fraction by this number. *d.* leaves the value unchanged).

3. Multiplying both terms by the same number (*a.* decreases the value of the fraction. *b.* increases the value. *c.* multiplies the fraction by this number. *d.* leaves the value unchanged).

4. Dividing both terms by the same number (*a.* divides the fraction by this number. *b.* leaves the value of the fraction unchanged. *c.* reduces the fraction to 1. *d.* multiplies the fraction by this number).

5. Multiplying the denominator by a number (*a.* multiplies the fraction by this number. *b.* increases the value. *c.* makes the fraction 0. *d.* divides the fraction by this number).

6. Dividing the denominator by a number (*a.* multiplies the fraction by this number. *b.* divides the fraction by this number. *c.* doubles the value. *d.* leaves the value unchanged).

7. Adding the same number to both terms (*a.* changes the value. *b.* leaves the value unchanged. *c.* increases the value. *d.* adds this number to the fraction).

8. Subtracting a number from both terms (*a.* changes the value of the fraction. *b.* decreases the value. *c.* leaves the value unchanged. *d.* subtracts this number from the fraction).

See how quickly you can state the answers:

1. 1×0
2. $0 \div 1$
3. $1 - 0$
4. $0 + 1$
5. 1×1
6. $1 - 1$
7. $1 \div 1$
8. $1 + 1$
9. $2 \div 2$
10. $2 - 2$
11. $\frac{1}{2} + \frac{1}{2}$
12. $\frac{1}{2} - \frac{1}{2}$
13. $\frac{1}{2} \div \frac{1}{2}$
14. $\frac{1}{2} \times \frac{1}{2}$
15. $\frac{3}{4} - \frac{3}{4}$
16. $\frac{3}{4} \div \frac{3}{4}$
17. $\frac{3}{4} \times \frac{3}{4}$
18. $\frac{3}{4} + \frac{3}{4}$
19. $\frac{7}{8} + \frac{3}{4}$
20. $\frac{7}{8} - \frac{3}{4}$
21. $\frac{5}{8} - \frac{1}{2}$
22. $\frac{1}{2} - \frac{3}{8}$
23. $\frac{5}{8} \times \frac{1}{2}$
24. $\frac{5}{8} \div \frac{1}{2}$
25. $\frac{1}{2} \div \frac{5}{8}$
26. $\frac{7}{8} \div \frac{1}{2}$
27. $\frac{7}{8} \times \frac{1}{2}$
28. $\frac{7}{8} - \frac{1}{2}$
29. $\frac{2}{3} \div 2$
30. $2 \div \frac{2}{3}$
31. $\frac{2}{3} \times \frac{3}{4}$
32. $\frac{3}{4} \times \frac{2}{3}$
33. $\frac{3}{4} \div \frac{2}{3}$
34. $\frac{2}{3} \div \frac{3}{4}$
35. $\frac{3}{4} \times \frac{4}{5}$
36. $\frac{3}{4} \div \frac{4}{5}$
37. $2\frac{1}{2} \times \frac{2}{3}$
38. $2\frac{1}{2} \div 1\frac{1}{4}$
39. $3\frac{3}{4} \div 1\frac{1}{4}$
40. $9\frac{1}{2} \div 2\frac{1}{3}$

Give the missing numbers:

41. $\frac{2}{3} =$ ——%
42. $2.5 \div 5 =$ ——
43. $2.5 \div 0.5 =$ ——
44. $2.5 \div 0.05 =$ ——
45. 75% of $4.008 =$ ——
46. $37\frac{1}{2}\% =$ —— of 100%
47. $\frac{1}{3}$ of $37\frac{1}{2}\% =$ ——
48. $0.62\frac{1}{2} =$ ——%
49. $\frac{1}{2}$ of $66\frac{2}{3}\% =$ ——
50. $87\frac{1}{2}\% =$ —— of 100%
51. $0.2 =$ ——%
52. $0.25 =$ ——%
53. $1.25 =$ ——%
54. $1\frac{1}{2} = 1.50 =$ ——%
55. $2\frac{3}{4} =$ —— = ——%
56. $3.75 \div 1.25 =$ ——
57. $150 \div 300 =$ ——%
58. $4 \div 5 = \frac{4}{\square} =$ ——%
59. $12 \div 16 = \frac{3}{\square} =$ ——%
60. $18 \div 27 = \frac{2}{\square} =$ ——%

DO YOU always read a problem through carefully before starting to solve it so that you will know exactly what you are to find? You may have to read it more than once.

Write the numbers 1 to 5 on your paper. Without solving the problem, write after each number the letter corresponding to the expression in parentheses which indicates what you are to find:

1. A man gave his note for $450 for 90 da. When he paid the note with interest at 6%, how much did he pay? (*a*. Interest. *b*. Sum of principal and interest. *c*. Amount borrowed. *d*. Rate of interest.)

2. Mr. Brown sold $6240 worth of goods and received a commission of 6%. How much did the company for which he worked receive from the sale? (*a*. Commission. *b*. Rate of commission. *c*. Proceeds. *d*. Interest.)

3. In a store where the overhead expenses average 28% of the sales, an article costing $9 was sold for $15. How much did the store make? (*a*. Per cent of profit. *b*. Overhead. *c*. Margin. *d*. Amount of profit.)

4. Tom Hackett saved $56.40 more this year than he did last year. How much more, on the average, did he save per month this year? (*a*. Amount saved last year. *b*. Average monthly increase in savings. *c*. Amount saved per month. *d*. Amount saved this year.)

5. Mr. James is buying a car that costs $775. If he pays $225 down and the balance in monthly installments of $55 each, how long will it take him to pay for the car? (*a*. Total cost of the car. *b*. Amount paid down. *c*. Number of monthly installments. *d*. Monthly interest.)

ON THIS page, the left-hand column shows things to be done, and the right-hand column shows, in a random order, how to do them. You are simply to **match the two columns; you need not find any of the answers.**

Write the numbers 1 to 12 on your paper, and after each write the letter that shows how to do the example:

1. Multiply $\frac{3}{5}$ by $\frac{1}{4}$.	*a.* Divide 48 by $1\frac{1}{4}$.
2. Find the number of which \$84 is $5\frac{1}{2}\%$.	*b.* Write the product of 3×4 over 5, and reduce.
3. Find 125% of 48.	*c.* Subtract 21 from 25.
4. Find what per cent 25 is of 21.	*d.* Put a decimal point in 125 after the 1.
5. Find the number of which 48 is 125%.	*e.* Write 3 over the product of 5×4.
6. Find the number that is $5\frac{1}{2}\%$ more than \$84.	*f.* Multiply \$84 by 0.945.
7. Find $5\frac{1}{2}\%$ of \$84.	*g.* Divide \$84 by 0.055.
8. Find how much less 21 is than 25.	*h.* Divide 25 by 21, and express the result as a per cent.
9. Find the number that is $5\frac{1}{2}\%$ less than \$84.	*i.* Multiply \$84 by 0.055.
10. Divide $\frac{3}{5}$ by $\frac{1}{4}$.	*j.* Reduce $\frac{125}{100}$.
11. Reduce 125% to a fraction.	*k.* Multiply 48 by $1\frac{1}{4}$.
12. Reduce 125% to a decimal.	*l.* Multiply \$84 by 1.055.

ON THIS page, you are to select from among the four computations in each set of parentheses the one that should be used in solving the example. You need not find the answers.

Write the numbers 1 to 11 on your paper, and after each write the letter that shows the computation you select:

1. What is the product of $2\frac{3}{4} \times 4\frac{5}{8}$? (*a.* $\frac{11}{4} \times \frac{8}{37}$. *b.* $\frac{11}{4} \times \frac{37}{8}$. *c.* $2 \times 4 + \frac{3}{4}$ of $\frac{5}{8}$. *d.* $\frac{4}{11} \times \frac{37}{8}$.)

2. What is the quotient of $11 \div 5\frac{1}{2}$? (*a.* $11 \div 5 + \frac{1}{2}$ of 11. *b.* $11 \times \frac{11}{2}$. *c.* $\frac{1}{11} \times \frac{11}{2}$. *d.* $11 \times \frac{2}{11}$.)

3. 5 is how much less than 25? (*a.* $25 - 5$. *b.* $\frac{1}{5}$ of 25. *c.* $5 \div 25$. *d.* $25 \div 5$.)

4. 5 is what per cent of 25? (*a.* $25 \div 5$. *b.* 0.05×25. *c.* $5 \div 25$. *d.* $25 \div 0.05$.)

5. What is $6\frac{1}{4}\%$ of \$720? (*a.* $\frac{1}{12} \times \$720$. *b.* $0.6\frac{1}{4} \times \$720$. *c.* $\$720 - 0.06\frac{1}{4}$. *d.* $0.06\frac{1}{4} \times \$720$.)

6. \$48.60 is what per cent of \$540? (*a.* $\$540 \div \$48.60$. *b.* $\$48.60 \div \$540$. *c.* $\$540 - \$48.60$. *d.* $\$48.60 \times \$540$.)

7. \$28 is 8% of what number? (*a.* $0.08 \div \$28$. *b.* $0.08 \times \$28$. *c.* $\$28 \div 0.08$. *d.* $\frac{1}{8}$ of \$28.)

8. \$135 is 10% less than what number? (*a.* $\$135 \div 0.90$. *b.* $0.10 \times \$135$. *c.* $\$135 - \$10$. *d.* $\$135 \div 0.10$.)

9. What number is 10% less than \$135? (*a.* $\$135 \div 0.90$. *b.* $\$135 - \$10$. *c.* $0.10 \times \$135$. *d.* $0.90 \times \$135$.)

10. \$244 is 10% more than what number? (*a.* $1.10 \times \$244$. *b.* $\$244 \div 1.10$. *c.* $\$244 - \$10$. *d.* $\$244 \div 0.90$.)

11. What number is 10% more than \$244? (*a.* $\$244 \div 1.10$. *b.* $\$244 + \$10$. *c.* $1.10 \times \$244$. *d.* $\$244 \div 0.90$.)

In each case first tell which of the four estimates in the parentheses you think is best, and then solve the example:

1. Find 28% of \$480. (\$125, \$280, \$100, \$508)

2. How much is 74% of \$6000? (\$150, \$1500, \$4500, \$7500)

Compare your answer with your estimate; if they differ very much, go over your work again.

3. Multiply \$4000 by 126. (\$48,000, \$50,000, \$3000, \$500,000)

4. In an arithmetic test containing 60 examples, Kate did 51 of them correctly. What was the per cent of correct answers? ($83\frac{1}{3}$%, $66\frac{2}{3}$%, 75%, 50%)

5. Mr. King's bank balance was \$272.80. After depositing \$24.60 and \$38.75, he drew a check for \$128.50. What was his balance then? (\$300, \$210, \$65, \$140)

6. In a recent year the rainfall by months in Los Angeles was 2.8 in., 2.9 in., 3.0 in., 1.1 in., 0.5 in., 0.1 in., 0.0 in., 0.0 in., 0.1 in., 0.8 in., 1.5 in., and 2.9 in. Find the average monthly rainfall for the year. (12 in., 0.5 in., 8 in., 1.5 in.)

7. In flying, a sparrow's wings beat an average of 13 times per second. This is an average of how many times per minute? (800, 60, 260, 72)

8. After his wages had been increased 5%, Mr. Dorr earned \$26.25 per week. How much per week did he earn before? (\$25, \$30.25, \$6.25, \$50)

9. In a certain kind of coal, the ashes left after burning are $19\frac{1}{2}$% of the original weight. How much ashes will there be from 2 T. of this coal? (400 lb., $19\frac{1}{2}$ lb., 800 lb., 4000 lb.)

THERE are a number of mistakes on this page. **See if you can find them all.** When you find an incorrect answer, give the correct one, numbering it with the example number.

Check these computations in the way that you think is easiest in each case:

1.	2.	3.	4.
\$21.48	746	1007	\$40.09
79.96	× 832	× 2068	46.37
7.70	1482	8156	67.89
56.89	2238	6142	8.98
79.97	5868	2114	85.76
+ 90.83	610662	280976	+ .68
\$326.83			\$249.77

5.	6.	7.	8.
\$428.30	10.07	0.48	\$901.06
− 129.42	6.8)684.76	37)16.76	− 743.56
\$398.88	68	148	\$157.50
	476	296	
	476	296	

9. $2\frac{1}{2} \times 2\frac{1}{2} = 2 \times 2 + \frac{1}{2} \times \frac{1}{2} = 4\frac{1}{4}$

10. $3\frac{3}{4} \div 3\frac{3}{4} = 3\frac{\cancel{3}}{\cancel{4}} \times 3\frac{\cancel{4}}{\cancel{3}} = 9$

11. $\frac{5}{16} \div \frac{5}{8} = \frac{5 \times 5}{16 \times 8} = \frac{25}{128}$

12. $\frac{2}{3} \div 3\frac{1}{2} = \frac{\cancel{2}}{3} \div \frac{7}{\cancel{2}} = \frac{7}{3} = 2\frac{1}{3}$

13. $\frac{3}{4} \times \frac{3}{8} = \frac{3 \times 3}{4 \times 8} = \frac{9}{32}$

14. 125% of \$480 $= 1\frac{1}{4} \times \$4.80 = \$6$

15. $\frac{1}{2}\%$ of \$128,500 $= 0.05 \times \$128{,}500 = \$6425$

1. A man whose bank balance was \$475.60 deposited \$250 and drew checks for \$45 and \$125. What was his new balance?

2. Jim had 45 correct answers on a test containing 50 examples. What per cent of the answers were right?

3. At 48 lb. to the bushel, what is the weight of a shipment of 500 bu. of apples?

4. Last year the total enrollment in a school was 518, and the average daily attendance was 495. To the nearest 0.1%, the daily attendance was what per cent of the enrollment?

5. What is the average speed per hour of a train that makes a trip of 58 mi. in 1 hr. 15 min.?

6. When a man with a yearly salary of \$3600 pays \$60 a month for the rent of his apartment, what per cent of his salary is he spending for rent?

7. Ned finds that the average length of his step is 26 in. If he walks $\frac{1}{2}$ mi. each way to school, how many steps does he have to take in going to and returning from school?

8. A salesman received \$402.50 as his commission on the sale of a house for \$11,500. What was the rate of commission?

9. A merchant borrowed \$5500 for 4 mo. at 6%. How much interest did he have to pay?

10. By keeping track of what she did each day, Betty found that she averaged 10 hr. for sleep, 2 hr. for meals, 5 hr. at school, 2 hr. for study and reading, 3 hr. for play, and 2 hr. for helping her mother. Find what per cent of the day Betty spent for each purpose. How does your day compare with Betty's?

11. In washing the windows of an office building, one man washed 5 windows per hour, and another man washed only 3. The slower man worked what per cent as fast as the other?

12. Jane's mother reads in the paper that there is going to be a sale of winter coats. At a discount of $33\frac{1}{3}\%$, for how much will she be able to buy a coat that has been marked \$42?

13. A dealer borrowed \$1500 for 15 da. at 6% in order to be able to take a cash discount of 2% on an invoice amounting to \$1525. How much more than the interest did he save by borrowing the money?

14. Last year in April there were 10 rainy days and 5 cloudy days, and the rest of the days were sunny. Draw a line 3 in. long and divide it so as to show what parts of the month were rainy, cloudy, and sunny.

15. It is estimated that people in the United States now use about 25 lb. of soap per person per year, while 10 yr. ago the amount was 22.5 lb. What is the per cent of increase?

16. The average weights of boys at different ages are as follows: 10 yr., 63 lb.; 11 yr., 69 lb.; 12 yr., 75 lb.; 13 yr., 84 lb.; 14 yr., 94 lb. Find the average yearly gain in weight for the 4 yr., and then find how much more or less each yearly gain is than this average.

17. In a store where the overhead expenses average 25% of the selling price, how much must be allowed for overhead on an article that sells for \$10? for \$15? for \$54?

18. A dealer pays \$12.40 apiece for some tables. If he allows 28% of the selling price for overhead expenses, for how much should he sell the tables in order to make a profit of 10% on the selling price?

19. The largest diamond ever found weighed $3034\frac{5}{8}$ carats before it was cut. The carat used in measuring jewels is approximately equivalent to 0.2 gram, and 1000 grams are equivalent to 2.2 lb. What was the weight in pounds of the diamond?

See how quickly you can do these examples:

1. 543	**2.** 8809	**3.** \$75.20	**4.** 0.15	**5.** 1.375
765	5137	12.75	6.00	.002
432	2042	1.09	7.25	9.657
+ 876	+ 1760	+ 29.27	+ 1.98	+ 3.050
6. 925	**7.** 506	**8.** \$95.75	**9.** $27\frac{1}{2}$	**10.** 829.4
− 775	− 497	− 67.98	$-19\frac{3}{4}$	− 608.5

See how quickly you can do these multiplications:

11. 285×962 **14.** $12\frac{1}{2} \times 225\frac{3}{4}$ **17.** 8.75×108.64

12. 137×549 **15.** $2 \times 3\frac{1}{7} \times 427$ **18.** 6.25×42.9

13. $1\frac{7}{8} \times 5280$ **16.** $0.235 \times \$975$ **19.** 0.175×987.4

See how quickly you can do these divisions:

20. $37\frac{1}{2} \div 2\frac{1}{2}$ **23.** $8946 \div 168$ **26.** $3.1416 \div 0.24$

21. $23\frac{1}{3} \div 3\frac{1}{2}$ **24.** $37{,}762 \div 237$ **27.** $35.568 \div 45.6$

22. $175 \div 7\frac{1}{2}$ **25.** $240.5 \div 1.04$ **28.** $5591.25 \div 1.065$

Find these per cents:

29. 25% of \$128

30. 15% of \$274.50

31. 0.8% of \$3175

32. 106% of \$75.80

33. 65% of \$8254

34. $4\frac{1}{2}$% of \$12,500

Find the interest due in each of these cases:

35. \$1250, 30 da., 6%

36. \$2400, 90 da., 5%

37. \$12,600, 12 da., 5%

38. \$35,400, 72 da., 6%

CHAPTER FOUR

FAMILIAR GEOMETRIC FORMS

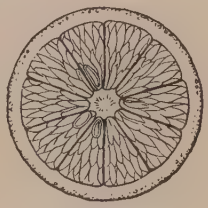
I. GEOMETRIC FORMS IN NATURE

Picnics and Geometry

ONE day Miss Gray's class had a picnic in the park. While they were eating their fruit, Jim cut an apple across in the middle. He found that it looked like the first picture below. Miss Gray said that in geometry the figure suggested by the outline of the apple in the picture is called a **circle.**

Apple

Banana



Orange

Betty cut across a banana to see what figure she could find. The result was a six-sided figure like the one shown above. When Tom cut across the middle of an orange, he found that the resulting figure was a circle divided into ten parts, with a ten-pointed star in the center.

The class was much interested in these figures, or **geometric forms.** They wanted to learn more about them.

THE day after the picnic, Miss Gray drew on the board the following geometric figures that are often found in nature. From the first two pictures, you can see that a **triangle** has

Equilateral triangle

Isosceles triangle

Circle

Regular pentagon

three (*tri-*) **angles and three sides**; that an **equilateral triangle** has its **three sides equal**, and its angles are also equal; and that an **isosceles triangle** has **two equal sides.**

The last figure shows a **pentagon**, which means "five-angled." In this case the five angles are equal, and so are the five sides. Such a figure is said to be **regular.** The equilateral triangle shown above might also be called a regular triangle.

Cotton boll

Sunflower

Spruce tree

1. Which of these pictures suggests an isosceles triangle?

2. How does the picture of the cotton boll suggest a pentagon inside a circle?

3. What figure does the sunflower suggest?

4. Name three leaves, flowers, plants, or trees that remind you of some of the geometric forms on this page.

1. Betty brought to class a clover leaf, an ivy leaf, and a pansy petal. She laid them on a piece of paper and drew out-

lines around them as shown above. Tell what geometric form is suggested by each leaf. Which figures are equilateral?

2. Mollie picked a wild rose and a dry seed pod. She drew their outlines on a piece of paper, as here shown. How many sides has each of the figures that she drew with straight lines? What is the name of the geometric figure that they suggest? See if you can name other flowers that suggest this form.

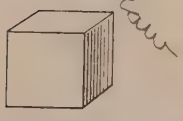
3. Miss Gray showed the class a fern, an oak leaf, and a maple leaf, which looked like the pictures below. She asked the

class to notice that in these leaves each half is almost like the other. Name other leaves or flowers in which this is true.

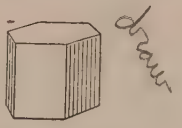
4. Bring to class any leaves, flowers, or fruit which you can find that suggest triangles, circles, or pentagons.

5. What kind of triangle is suggested by the gable end of a house with the common type of A-roof? See if you can find other triangles in buildings.

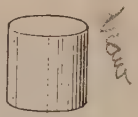
MISS GRAY drew on the board pictures of the **geometric solids** shown below. She then asked the class to see if they could find examples of these solids and to describe them.



Cube



Hexagonal prism

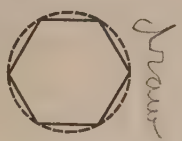


Cylinder

Cone

Jim brought her a yellow drawing eraser in the form of a **cube.** He found by counting that a cube has **six faces, twelve edges,** and **eight vertices** (or **corners**). He also noticed that each face of the cube is a **square,** which is a geometric figure with **four equal sides and four equal angles.**

Mary said that a piece of her six-sided pencil would look like the **hexagonal prism.** "Hexagon" means "six-angled." The picture at the right shows a **regular hexagon** inside a circle. The **bases** of the hexagonal prism shown above, on one of which it is standing, are both regular hexagons.



Anne suggested that a piece of her round pencil would be like the **cylinder.** Jean gave telegraph poles and water pipes as examples of cylinders. Edith said that when you cut across such cylinders, **the ends are circles.**

Ralph suggested an ice-cream cone as an example of the **cone.** The pointed end of a cone is called its **vertex.** In the common type of cone, **the base is a circle.**

All these solids are found in nature, — the cube in rocks and some metal crystals, such as lead; the hexagonal prism in rocks and quartz crystals; the cylinder in tree trunks and plant stems; the cone in flowers and evergreen trees.

YOU are now familiar with several kinds of geometric figures, and you should be able to draw free-hand pictures of them. Use a sharp pencil and make your drawings neatly.

1. Draw a square and then copy and complete this statement: **A square has 4 equal sides and 4 equal angles.**

2. Draw a regular hexagon and then copy and complete this statement: **A regular hexagon has six equal sides and 6 equal angles.**

3. Draw an equilateral triangle and then copy and complete this statement: **An equilateral triangle has 3 equal sides and three equal angles.**

4. Draw an isosceles triangle and then copy and complete this statement: **An isosceles triangle has 2 equal sides.**

Here are some pictures of wild flowers. Draw free-hand the geometric figure which each one suggests and write its name beneath:

5.

Lily

6.

Bluebells

7.

Trillium

8.

Chickweed

Write the name of something in nature that suggests

9. A cylinder.
10. A triangle.
11. A circle.
12. A cone.
13. A regular hexagon.
14. A regular pentagon.

15. See if you can find examples of circles, triangles, squares, cylinders, and cones in the schoolroom.

1. The perimeter of a figure is the distance around it. Find the perimeter (the sum of the lengths of the sides) of an equilateral triangle with sides of 2 in.

2. Find the perimeter of a square with sides of $1\frac{1}{2}$ in.; of a regular hexagon with sides of 1.75 in.; of a regular pentagon with sides of $1\frac{5}{8}$ in.

3. The perimeter of a flower bed 3 ft. square is what per cent of that of a bed 6 ft. square?

4. The perimeter of an equilateral triangle with sides $2\frac{1}{2}$ in. long is what per cent more or less than that of an equilateral triangle with sides $7\frac{1}{2}$ in. long?

Copy these additions, putting in the missing numbers:

5.	6.	7.	8.	9.
\$2.73	5.98	\$6.66	\$1.4*	2 lb. 4 oz.
4.81	9.86	4.64	*.58	3 lb. 6 oz.
3.42	8.47	1.95	4.39	0 lb. 12 oz.
*.**	3.72	9.*7	5.96	* lb. 8 oz.
.36	6.07	.8*	7.70	5 lb. * oz.
1.09	.99	5.98	2.60	3 lb. 3 oz.
\$15.00	**.**	\$29.54	\$24.*8	18 lb. 9 oz.

See how long it takes you to do these examples:

10. $2\frac{7}{8} + 3\frac{3}{4}$

11. $5\frac{4}{5} - 1\frac{1}{2}$

12. $11\frac{1}{4} \div 3\frac{3}{4}$

13. $6\frac{2}{3} \times 12\frac{1}{2}$

14. $16\frac{1}{2} \div 4\frac{1}{8}$

15. $7\overline{)0.049}$

16. $0.3\overline{)13.26}$

17. $0.05\overline{)68.5}$

18. $0.006\overline{)0.336}$

19. $0.005\overline{)4.525}$

20. 4.8×62.4

21. 0.7×14.03

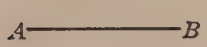
22. 0.0015×3.2

23. $4.72 \times 12\frac{1}{2}$

24. $1.055 \times \$17{,}500$

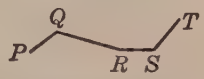
Learning about Lines and Angles

IN DESCRIBING geometric figures that you find in nature and elsewhere, you will need some new words. Below are some of these terms with pictures to show what they mean.

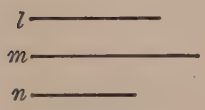


Straight line *AB*

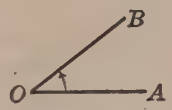
Curve *XY*



Broken line *PQRST*



Parallel lines, *l*, *m*, and *n*



Angle *O*, or angle *AOB*

Equal angles, *m* and *n*

Right angle (90°)

Acute angle (less than 90°)

Obtuse angle (more than 90°)

Name something in nature that makes you think of

1. A straight line.
2. A curve.
3. A broken line.
4. Equal angles.
5. Parallel lines.
6. A right angle.

Referring to the pictures at the top of the page, tell which figure the hands of a clock illustrate at

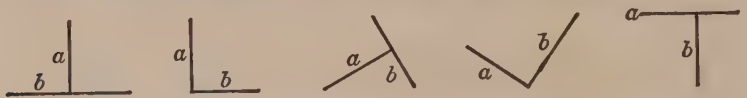
7. 6 o'clock.
8. 3 o'clock.
9. Noon.
10. 4 o'clock.
11. 2 o'clock.
12. This moment.

EVERY right angle contains 90°, and so **all right angles are equal in size.** The size of an angle is measured by the **amount of turning** of the sides (or arms) about the **vertex,** — the point at which the sides of the angle meet each other.

The above pictures also show that **the size of an angle does not depend upon the lengths of its sides.** You can also see this in the picture of the equal angles m and n on page 187.

The sides of a right angle are perpendicular to each other.

In the figures below, the lines a and b in each case meet at right angles, and so they are **perpendicular to each other.** Such

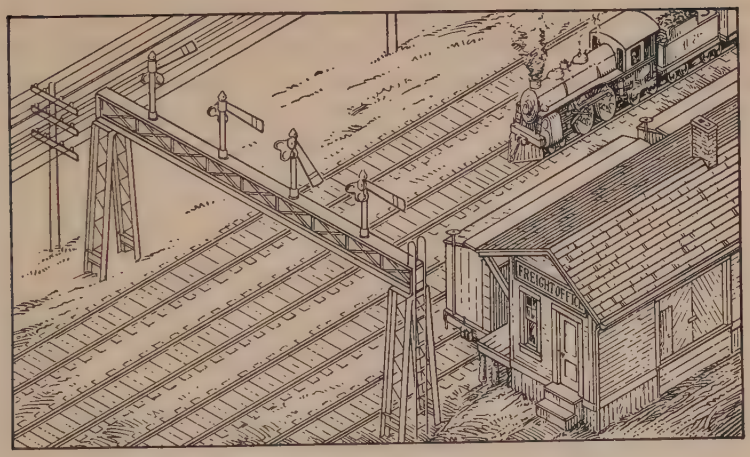


lines are called **perpendicular lines.** You will frequently find perpendicular lines in buildings. See if you can find several examples of them in the schoolroom.

Other lines about which you often hear are **horizontal, vertical,** and **slanting lines.** These are shown below. It will help

Horizontal line **Vertical lines** **Slanting lines**

you to learn these terms if you remember that horizontal lines point to the horizon, and vertical (up-and-down) lines are perpendicular to horizontal lines.



In the above picture, find three or four examples each of

1. Parallel lines; horizontal lines; vertical lines; slanting lines; curves.

2. Right angles; obtuse angles; acute angles.

3. Triangles; cylinders; circles; perpendicular lines.

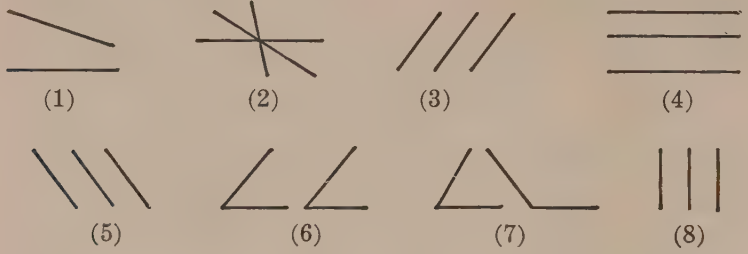
4. Find three sets of lines in the picture that are both vertical and parallel.

5. Find three sets of lines in the picture that are both horizontal and parallel.

6. What kinds of triangles can you find in the framework of the signal bridge? Draw larger pictures of these triangles and write the names beneath them.

7. See if you can find any examples of squares in the picture. If you are looking for a square, what two facts about the sides and angles of a square should you remember?

Write the numbers 1 to 10 in a column on your paper, and after each write the number, or numbers, of the figures (1) to (8) which illustrate the terms listed in Exs. 1 to 10, below:



1. Parallel lines.
2. Lines not parallel.
3. Horizontal lines.
4. Vertical lines.
5. Slanting lines.
6. Equal angles.
7. Unequal angles.
8. Acute angles.
9. Obtuse angles.
10. Vertical parallel lines.

11. How many degrees are there in a right angle? How many right angles are there in a square? How many degrees are there in all the angles of a square?

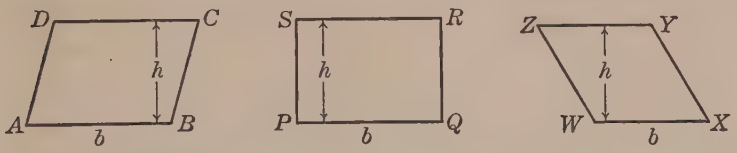
12. Draw free-hand three right angles in different positions; three acute angles of different sizes; three obtuse angles of different sizes.

13. Draw a vertical line meeting a horizontal line, and write the name of the angle (or angles) thus formed.

14. Draw a slanting line which is perpendicular to another slanting line.

15. Draw two pictures of a clock to show two different hours when the hands are perpendicular to each other.

ANOTHER important figure is the **parallelogram**, the name applied to any four-sided figure in which the opposite sides are parallel. These three figures are parallelograms.



In a parallelogram the opposite sides not only are parallel but they also are equal, and the opposite angles are equal.

As you probably know, the parallelogram *PQRS* shown above is generally called by the special name **rectangle.** A rectangle is a parallelogram in which **all the angles are right angles,** and hence are equal.

A square (page 184) is also a special kind of parallelogram.

The third parallelogram, which is *WXYZ,* is often called by the special name **rhombus.** A rhombus is a parallelogram **in which all the sides are equal.**

The meaning and use of the term **base** (usually abbreviated to *b*), which is applied to *AB*, *PQ*, and *WX*, and of **height** (usually abbreviated to *h*) are evident from the figures.

Read and complete these statements:

1. In the parallelogram *ABCD*, *AB* (or *b*) is parallel to ——— and equal to ———. *AD* is equal and parallel to ———.

2. In the rectangle *PQRS*, the angles are ——— angles and each side is ——— to two others.

3. In the rhombus *WXYZ*, *WX* and *ZY* are ——— and ——— to each other. The base is *b* or ———, and the height is ———.

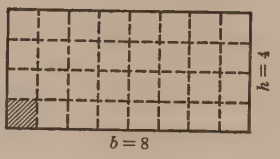
Area of a Rectangle

AS YOU learned last year, the size of a surface is measured in **units of area** such as 1 sq. in., 1 sq. ft., and the like. This square, which is drawn full size, is called a **1-inch square** because it is 1 in. on each of its four sides. **The area of a 1-inch square is 1 sq. in.**

Area of this 1-inch square is 1 sq. in.

Any other figure, such as a triangle, a rectangle, a parallelogram, or a circle, can have an area of 1 sq. in.

Here is a picture of a rectangle in which the length (or base) is 8 ft. and the width (or height) is 4 ft. As you also learned last year, or as you can easily see from the picture, the number of square feet in the area of this rectangle is 8×4, or 32; that is,



Area in square feet $= 8 \times 4$, or 32.

Briefly expressed, the familiar rule for finding the area of a rectangle is

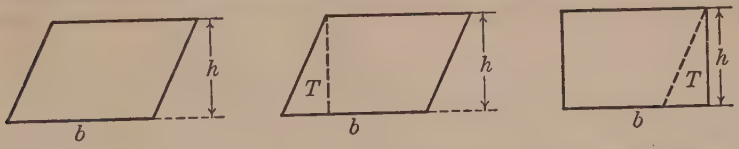
Area = base × height.

1. Find the area of a rectangle that is 5 in. long and $2\frac{1}{2}$ in. wide; of one that has a base of 6 in. and a height of $3\frac{1}{2}$ in.

Find the areas of rectangles with these dimensions:

2. 17 in. by 6 in.
3. $14\frac{1}{2}$ in. by 8 in.
4. 16 in. by $7\frac{1}{2}$ in.
5. $4\frac{1}{2}$ in. by $2\frac{1}{4}$ in.
6. 5 ft. 6 in. by 2 ft.
7. 12 ft. by 4 ft. 6 in.
8. 160 rd. by 40 rd.
9. 14 ft. 8 in. by 10 ft.

THE pictures below show how you can find the area of a parallelogram. As you can easily see, if you cut off the triangle T, as in the second picture, and put the two pieces together again, as in the third picture, you have a rectangle with the same base and height as the original parallelogram.



The rule for finding the area of a parallelogram is therefore the same as that for a rectangle; namely,

Area = base × height.

---

1. Cut out a paper parallelogram of this shape. Then cut off a triangle at one end, as in the figures above, and place it at the other end. What is the shape of the new figure thus formed? How do you find its area?

Find the areas of parallelograms with these dimensions:

	Base	Height
2.	14 in.	7 in.
3.	16 in.	9 in.
4.	$15\frac{1}{2}$ ft.	6 ft.
5.	23 yd.	$8\frac{1}{2}$ yd.
6.	$16\frac{1}{2}$ rd.	$2\frac{1}{4}$ rd.

	Base	Height
7.	15 in.	10 in.
8.	$18\frac{3}{4}$ mi.	12 mi.
9.	$12\frac{1}{2}$ yd.	$12\frac{1}{2}$ yd.
10.	$16\frac{2}{3}$ ft.	$6\frac{3}{4}$ ft.
11.	$17\frac{1}{8}$ in.	$12\frac{1}{2}$ in.

1. A classroom is 36 ft. long and 24 ft. 6 in. wide. What is the area of the floor?

2. The top of a desk is 20 in. long and $14\frac{1}{4}$ in. wide. What is the area of the desk top?

3. Bob and Jack measured the school playground and found that it was 240 ft. long and 150 ft. wide. Find the area in square yards, first by finding the area in square feet and reducing to square yards, and then by reducing the dimensions to yards and finding the area in square yards. Which do you think is the easier plan in this case?

4. A plan of some house lots showed (1) a square 250 ft. on a side, (2) a parallelogram with a base of 425 ft. and a height of 310 ft., and (3) a rectangle 532 ft. long and 445 ft. wide. Find the area of each lot in square feet, and also the total area of the three lots.

5. What per cent of the floor space of a dining room 16 ft. long and 14 ft. wide will be covered by a rug 12 ft. square?

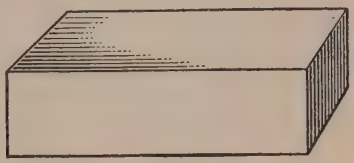
6. Compare the area of a rectangle which is 5 in. by 4 in. with that of one which is 10 in. by 2 in. Find three different sets of dimensions that could be used for a rectangle which is to contain 30 sq. in.

7. Mr. Brown calls one of his pastures "the 10-acre field." The pasture is a square approximately 40 rd. on a side. There are 160 sq. rd. in an acre. Is the name a good one?

8. Mr. Rogers is planning to raise 250 turkeys for the Thanksgiving market this year. If he allows $2\frac{1}{2}$ sq. yd. of yard space for each bird, how many square feet of ground will the yard cover? If he makes the yard rectangular, with one side 125 ft. long, how long will the other side be?

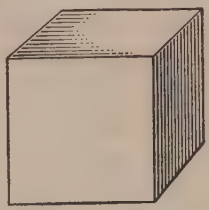
Rectangular Solids and Cubes

ONE of the most common geometric solids is the **rectangular solid** here illustrated. See if you can find some example of this solid in the schoolroom. How many faces has it? How many edges? How many vertices (corners)? In the picture at the right, how many of the faces do not show?



In a rectangular solid, **all the faces are rectangles.** The angles in each face are therefore all right angles, and the opposite edges of the solid are both equal and parallel.

You have already learned something about the geometric solid called the cube (page 184). A **cube** is a rectangular solid in which **all the faces are squares.** See if you can find a cube in the schoolroom.



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1. A cube has how many faces? What shape are they? What can you say about the edges of a cube?

2. If the rectangular solid shown above is 4 in. long, 2 in. wide, and 1 in. high, what is the area of the bottom face? the top face? the front face? the back face? each end face?

3. In Ex. 2, what is the area of the total surface?

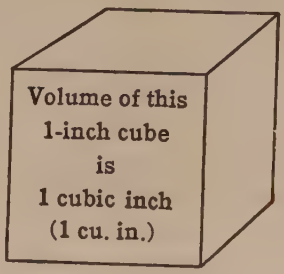
4. What is the area of the total surface of a 1-inch cube?

5. What is the area of the total surface of a 2-inch cube?

6. The answer in Ex. 5 is how many times larger than that in Ex. 4? What does doubling the length of the edge of a cube do to the area of the total surface?

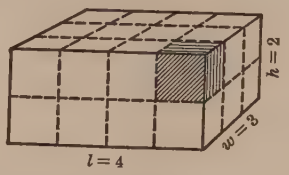
Volume of a Rectangular Solid

AS YOU learned last year, the volume of a solid is measured in cubic units such as 1 cu. in., 1 cu. ft., 1 cu. yd., and the like. Here is a picture of a cube that measures 1 in. on each edge. **The volume of a cube that is 1 in. on an edge is 1 cu. in.**



A solid of any other shape, such as a ball, a cylinder, or a cone, can have a volume of 1 cu. in.; a solid does not have to be a cube in order to contain 1 cu. in.

Here is a picture of a rectangular solid that is 4 in. long, 3 in. wide, and 2 in. high. The shaded part represents a 1-inch cube, and the dotted lines show how you can think of the solid as being divided into 1-inch cubes.



As you can easily see, the number of cubic inches in the volume of the solid is $4 \times 3 \times 2$, or 24.

Briefly expressed, the familiar rule for finding the volume of a rectangular solid is

Volume = length × width × height.

1. Find the volume of a rectangular solid that is 6 in. long, 4 in. wide, and 3 in. high.

2. Find the volume of a rectangular solid in which the dimensions are 5 ft., 3 ft., and 2 ft.

3. Find the volume of a cube that is 2 in. on an edge; of a cube that is 4 in. on an edge.

4. The body of a farm wagon is 9 ft. long, 3 ft. 2 in. wide, and 26 in. deep. Find its capacity (volume) in cubic feet.

5. A cellar 36 ft. long and 24 ft. wide was dug to a depth of 7 ft. How many cubic yards of earth were removed?

6. Jim found a box that was 15 in. square and 15 in. deep, inside measurements. What was its capacity in cubic feet?

7. The **standard cord** of wood contains **128 cu. ft.** How many such cords are there in a pile of wood that is 50 ft. long, 4 ft. wide, and 6 ft. high?

8. A rectangular cake of ice measured 1 ft. 8 in. by 1 ft. by 9 in. At 57.3 lb. to the cubic foot, how much did it weigh?

9. How many cubic yards of earth will a city water department have to remove in digging 1800 ft. of trench $2\frac{1}{2}$ ft. wide and 6 ft. deep?

10. A rectangular water tank 10 ft. long and $8\frac{1}{2}$ ft. wide is filled to a depth of 6 ft. How many cubic feet of water does it contain? At $62\frac{1}{2}$ lb. to the cubic foot, how much does the water in the tank weigh?

11. A farmer shipped some wheat in a freight car that was 36 ft. long and 8 ft. 4 in. wide, inside measurements. The car was filled to a depth of 4 ft. 3 in. At $1\frac{1}{4}$ cu. ft. to a bushel, how many bushels were there in the car?

12. In building 4 mi. of a 40-foot state highway, a layer of crushed rock was spread over the road to an average depth of 6 in. How many cubic yards did it take?

13. Mary made a pasteboard box that measured 5 in. by 4 in. by 2 in., inside measurements. If she makes another with each dimension just half as long, the capacity of the smaller box will be what fraction of that of the larger one?

IN DRAWING pictures of solids the back edges that are hidden from view are frequently represented by dotted lines, as in these figures which show four different kinds of **prisms**:

Square

Triangular

Hexagonal

General

The names under the pictures show how the prisms are named **according to the shape of the bases.** You have already studied the hexagonal prism, which is sometimes found in nature (page 184). The name "general" is applied to any prism in which the bases have no special shape, but are any kind of figure formed by straight lines.

In any prism, as you can see, **the two bases are equal and parallel and the other faces are parallelograms.**

Another geometric solid that you will frequently see is the **pyramid.** Here are four different kinds of common pyramids:

Square

Triangular

Pentagonal

Hexagonal

Later, when you study geometry, you will need to learn more about the different kinds of prisms and pyramids and about the special names given to their various parts. At present, you need simply learn what these solids look like, so that when you see an object with any of these shapes you will know its name.

After studying figures (1) to (8), tell what should go in the blank spaces in Exs. 1 to 11, below:

(1)

(2)

(3)

(4)

(5)

(6)

(7)

(8)

1. The prisms are figures 2, 4, 6, 8.
2. The pyramids are figures 1, 3, 5, 7.
3. The rectangular solids are figures 2 and 8.
4. The name usually applied to figure (2) is cube.
5. Figure (4) is a pentagonal prism, figure (6) is a triangular prism, and figure (8) is a hexagonal prism.
6. Figure (1) is a square pyramid, figure (3) is a pentagonal pyramid, and figure (7) is a hexagonal pyramid.
7. A square prism has 6 faces, a pentagonal prism has 7, and a triangular prism has 5.
8. A triangular pyramid has 4 faces, a hexagonal pyramid has 7, and a square pyramid has 5.
9. A pentagonal prism has 10 vertices (corners), a triangular prism has 6, and a square prism has 8.
10. A hexagonal pyramid has 7 vertices, a triangular pyramid has 4, and a square pyramid has 5.
11. A triangular pyramid has 6 edges, a pentagonal prism has 15, and a hexagonal pyramid has 12.

1. At 8¢ a yard, how much will it cost to hemstitch the four edges of a tablecloth 3 yd. long and 2 yd. wide?

2. In painting the inside of a rectangular covered box $4\frac{1}{2}$ ft. long, $2\frac{1}{2}$ ft. wide, and 1 ft. 9 in. deep, inside measurements, how many square feet of surface, including the cover, are to be painted?

3. Mary's grandmother made a quilt 6 ft. long and 4 ft. wide by piecing together colored pieces of cloth, each 3 in. square. How many little squares did she use?

4. The aquarium for John's goldfish is 15 in. long, $10\frac{1}{2}$ in. wide, and $8\frac{1}{2}$ in. deep. How many cubic inches of water does it hold when filled to within 2 in. of the top?

Find the area of each of the following figures:

5. Square, 5 in. on an edge.

6. Rectangle, 4 in. long and $3\frac{1}{4}$ in. wide.

7. Parallelogram, base of $6\frac{1}{2}$ in. and height of $4\frac{1}{2}$ in.

Find the volume of each of the following solids:

8. Cube, $3\frac{1}{2}$ in. on an edge.

9. Rectangular solid, 6 ft. by $4\frac{1}{2}$ ft. by $3\frac{1}{4}$ ft.

See how quickly you can do these examples:

10. $3\frac{1}{2} \times 2\frac{1}{4}$

11. $8\frac{2}{3} \times 6\frac{1}{2}$

12. $7 \times 5\frac{3}{8}$

13. 5.5×3.4

14. $9\frac{1}{4} \times 6\frac{1}{2}$

15. $0.06 \times 9\frac{1}{2}$

16. 6×8.25

17. 3.5×7.5

18. $9 \times 4\frac{1}{2} \times 2$

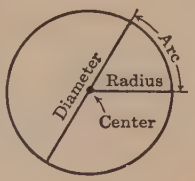
19. $12\frac{3}{8} \times 9\frac{1}{4} \times 2\frac{2}{3}$

20. $5280 \times 4 \times \frac{7}{12}$

21. $9 \times 3\frac{1}{2} \times 62\frac{1}{2}$

Circles and Spheres

ONE of the geometric forms most common in nature and in the things you use or see every day is the circle. This picture shows the special names that are used for different parts of the circle.



The name **circle** is given to the curve line itself or to the figure formed by the line, and the name **circumference** means the length of the curve line; that is, it is the distance around the circle.

As you can see from the picture, any line from the **center** to the circle is called a **radius** (the plural of which is **radii**). A **diameter** is a line straight across the circle, passing through the center. An **arc** is any part of a circle.

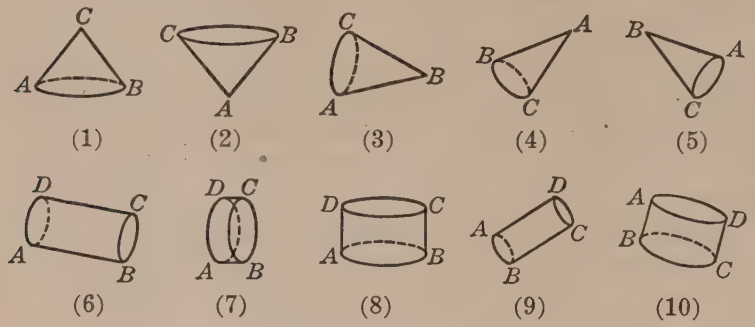
Since the center of a circle is always at the same distance from all parts of the circle, all the radii of a circle are equal in length.

A **semicircle**, as the name suggests, is half a circle. The picture at the right shows that the names for the parts of a semicircle are the same as those used for the circle.

Another geometric solid is the round solid called the **sphere**. Oranges, balls, and many other common objects have this shape. Every point on the surface of a sphere is at the same distance from the center. The names radius and diameter are used for a sphere just as for a circle.

The picture at the right of the sphere shows a **hemisphere**, which is half a sphere.

IN STUDYING about geometric forms in nature (page 184), you learned about **cones** and **cylinders**. Although solids are often represented as standing on some face (the base), they may, as shown in the figures below, be drawn in any position.



1. In figure (1), the base is lettered AB and the vertex C. What is the vertex in figure (2)? in figure (3)?

2. Name the vertex in figure (4); in figure (5).

3. A cylinder has two bases. Name the bases in each of figures (6) to (10).

4. The **height of a cone** is the distance from the vertex to the base, measured perpendicularly to the base. In figure (1), the height is measured from C to AB. How is the height measured in each of figures (2) to (5)?

5. The **height of a cylinder** is the distance between the bases. In figure (6), the height is AB or DC. Name the height in each of figures (7) to (10).

6. Draw free-hand a picture of a cylinder standing on one of its bases, and on top of the cylinder draw a cone.

1. What geometric figure does a rainbow suggest?

2. Mrs. Rice cut a pie across the middle. What geometric terms are illustrated by each half of the pie?

Name the geometric form that is suggested by

3. Half of an orange or a grapefruit.

4. Half of a thin round cookie; half of a round loaf of cake.

5. Draw simple free-hand sketches of these flowers, and on them show by dotted lines (1) how the morning-glory suggests

Morning-glory

Forget-me-not

Trumpet flower

Primrose

a cone; (2) how the forget-me-not suggests a pentagon; (3) how the trumpet flower suggests a square pyramid; and (4) how the primrose suggests a square.

6. Find the length of the diameter of a circle when the radius is $3\frac{1}{2}$ in.; 2 ft. 7 in.; $4\frac{7}{8}$ in.; 2.5 in.

7. Find the length of the radius of a circle when the diameter is $3\frac{1}{2}$ in.; 4 ft. 3 in.; $5\frac{3}{4}$ in.

Name the figure illustrated by the hands of a clock at

8. 3 o'clock.
9. 6 o'clock.
10. 12 o'clock.
11. 5 o'clock.
12. 1 o'clock.
13. This moment.

14. Make a list of three pairs of perpendicular lines that you can see in the schoolroom.

15. Make a list of three pairs of parallel lines that you can see in the schoolroom.

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. How many cubic feet of earth are needed to spread a layer 3 in. deep over a rectangular flower bed 10 ft. long and 4 ft. wide?

2. How many square yards of roofing material will it take to cover a rectangular porch roof 18 ft. by 12 ft.?

3. Jack sold for $10.80 a bicycle for which he paid $18. He received what per cent less than he paid?

4. There are $1\frac{1}{4}$ cu. ft. in a bushel. How many bushels of corn can be put in a bin 8 ft. by 5 ft. by 3 ft.?

5. At 4%, to how much will the commission amount on the sale of a house for $10,500?

6. A ton of hay occupies about 500 cu. ft. of space. Find the weight of the hay in a mow 10 ft. by 9 ft. by 8 ft.

7. When 75 pupils are graduated from a school of 400, what per cent of the school is graduated?

8. Mr. Wade borrowed $1650 for 90 da. at 6%. How much was the interest?

9. The area of a square 4 in. on a side is what per cent of that of a square 8 in. on a side?

10. At 22¢ per gallon, how much will the gasoline cost for a trip of 216 mi. in an automobile that averages 18 mi. to each gallon of gasoline?

Geometry and Drawing

ANOTHER day Miss Gray and the class talked about geometric forms in relation to their drawing work and art. She drew these figures on the board for the class to discuss.

(1) (2) (3) (4)

Tell what should go in the blank spaces in Exs. 1 to 7:

1. Figure (1) shows a slanting line and a ___ line.

2. Figure (2) shows ___ slanting lines that are ___.

3. In figure (1), the slanting line is said to be **oblique** to the horizontal line. In figure (4), two of the sides of the parallelogram are ___ to the bases.

4. Figure ___ is the only one which contains vertical lines.

5. In figures (3) and (4), the opposite sides in each case are both equal and ___.

6. A rectangle has ___ right angles.

7. The opposite angles of a parallelogram are ___

8. Draw a rectangle; a parallelogram; a square.

9. Draw a horizontal line and two lines oblique to it.

10. Draw two horizontal parallel lines.

11. Draw three vertical parallel lines.

12. Draw two horizontal parallel lines and then draw a line crossing them at right angles.

DID you ever try to see how many geometric figures you could find in any room in which you happened to be? Here is a picture of a room in which geometric figures have been freely used in the decorations and furnishings. Study it carefully.

1. The rug in the picture is made up of squares. See how many other squares you can find in the picture.

2. See how many rectangles you can find in the picture.

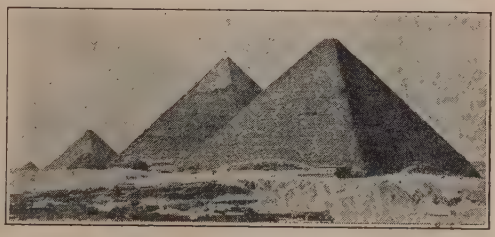
3. See how many circles you can find in the picture.

4. Pick out two or more pairs of vertical parallel lines in the picture. Find some slanting parallel lines.

Look around your home and bring to class a list which will show examples of as many of these figures as you can find:

5. Horizontal line.
6. Vertical line.
7. Straight line.
8. Curve.
9. Slanting line.
10. Parallel lines.
11. Perpendicular lines.
12. Acute angle.
13. Obtuse angle.
14. Right angle.
15. Circle.
16. Cylinder.
17. Triangle.
18. Rectangle.

1. Here is a picture of the pyramids in Egypt. Draw a pyramid which has this general shape, using a dotted line to show the back edges of the base (which should be a square). Draw a picture of one of the side faces of the pyramid. What kind of triangle is it?



2. See if you can find a picture of an Eskimo house (igloo) in your geography. What is the name of the geometric solid that it suggests? Draw this solid.

3. Draw a picture of some tank that you have seen which has the shape of a cylinder. If you have seen one with a hemisphere on the top, draw it that way.

Draw these figures as neatly as you can:

4. A circle with a diameter of about 2 in. Draw a radius, marking it OA, and a diameter, marking it XY.

5. A semicircle with a diameter of about 2 in.

6. A circle about 1 in. in diameter with a square inside it.

7. A semicircle about 1 in. in diameter with an isosceles triangle inside it.

8. A rectangular solid; a cube.

9. A square prism; a square pyramid.

10. A triangular pyramid; a triangular prism.

11. A cone standing on its base.

12. A cylinder lying on its side; one standing upright.

HERE is a picture of one of the most beautiful buildings in the world. This building, which is called the Taj Mahal (tȧj mȧ-häl′), is located at Agra, India, and was built in 1632. The large domes on the top resemble hemispheres, although they are not, of course, exactly that shape.

Read and complete the following statements:

1. The towers around the building suggest ——.
2. Horizontal lines are seen in ——.
3. Vertical lines are seen in ——.
4. Parallel lines are seen in ——.
5. Right angles are seen in ——.
6. The outline of a rectangle is seen in ——.
7. The bases of the three large domes on top of the building have the shape of ——.
8. The arches that form the tops of the doorways and windows are combinations of ——.

THIS is a picture of a Gothic window in the great cathedral at Rheims, France. The many colors used in the glass of the window help to bring out the grace of the design, which is based on a skillful use of geometric forms.

1. What is the shape of the main part of the window?

2. If you partly close your eyes as you look at the picture, you will see that the main part suggests a huge flower. How many petals are there in this flower?

3. How many straight lines can you find in the main part?

4. What kind of lines are used in the arches over the window?

5. Draw free-hand a small sketch of the part of the window that seems to you to have the greatest beauty. If you have colored crayons, try coloring some of the spaces to suggest the colored glass in the original window.

6. Make up a design for a similar window. Put in as many different geometric forms as you can, but do not use any form that does not add to the beauty of the design.

1. Find the number of square rods in a rectangular field that is 264 ft. long and 240 ft. wide. (1 rd. $= 16\frac{1}{2}$ ft.)

2. What dimensions do you need to know in order to find the area of a rectangle? the area of a square? the volume of a cube? the volume of a rectangular solid?

3. At 8%, how much commission does a salesman earn in selling a motor truck for $2400?

4. Mr. Jackson paid $25.60 for an overcoat which had been reduced 20%. What was the original price?

Find the areas of rectangles with these dimensions:

5. $6\frac{1}{2}$ in. by $4\frac{1}{4}$ in.
6. 5 ft. 6 in. by 3 ft. 4 in.
7. 25 yd. by 45 ft.
8. $8\frac{3}{4}$ yd. by $3\frac{1}{4}$ yd.

See how quickly you can do these additions:

9.	10.	11.	12.
991	664	5.34	63.2
956	319	.43	81.4
868	605	7.75	7.1
677	840	2.04	.9

See how quickly you can do these subtractions:

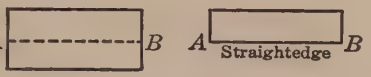
13.	14.	15.	16.
93.76	70.01	5.027	80.2
43.29	8.96	3.861	56.7

See how quickly you can do these multiplications:

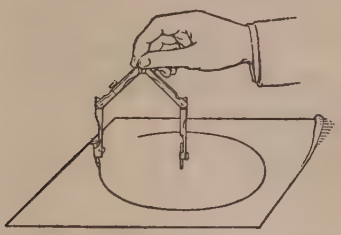
17.	18.	19.	20.
207	5.42	35.6	8.19
96	187	5.3	0.12

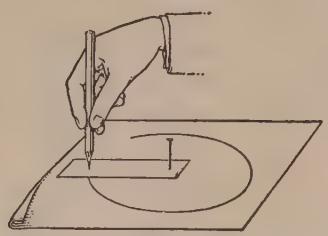
Using Drawing Instruments

YOU will be able to make much neater and more accurate drawings of geometric figures **if you use drawing instruments.** In drawing straight lines you can use a **ruler,** or you can make a **straightedge** by folding a piece of paper as shown in these two pictures. The folded edge AB will serve as a ruler.



For drawing circles and arcs, you can use **compasses,** as shown in the first picture below. If you have no compasses,

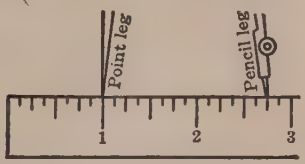




you can trace carefully around a coin, or other round object, or you can use a pencil with a pin and a strip of stiff paper, as shown in the second picture.

A neat workman always keeps his pencil well sharpened.

This picture shows how to use your ruler in setting the legs of the compasses to draw a circle with a radius of $1\frac{3}{4}$ in. After setting the compasses, be careful not to change the setting until you have drawn the circle. The large picture above at the left shows you how to hold the compasses while drawing the circle.



Using a ruler, draw acute angles with sides of these lengths:

1. 1 in., 2 in.
2. 2 in., 3 in.
3. $1\frac{1}{2}$ in., 2 in.
4. $2\frac{1}{4}$ in., 3 in.
5. $2\frac{3}{4}$ in., 2 in.
6. 3 in., $2\frac{7}{8}$ in.

Using a ruler, draw obtuse angles with sides of these lengths:

7. 2 in., 2 in.
8. 1 in., 2 in.
9. 3 in., 3 in.
10. 3 in., 2 in.
11. 3 in., $\frac{1}{2}$ in.
12. $3\frac{1}{8}$ in., $2\frac{7}{8}$ in.

Draw circles with these radii:

13. 1 in.
14. 2 in.
15. $1\frac{1}{2}$ in.
16. $2\frac{1}{8}$ in.
17. $1\frac{7}{8}$ in.

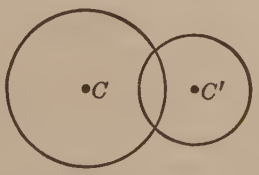
18. In drawings it is frequently more convenient to use the marks ′ and ″ in place of the abbreviations "ft." and "in." What is the diameter of a circle which has a radius of $1\frac{7}{8}$″? of 2.7″? of 5.2′? of 3′ 6″ (which means 3 ft. 6 in.)?

19. What is the radius of a circle which has a diameter of 9″? of $7\frac{1}{2}$′? of $3\frac{1}{4}$″? of 4′ 6″? of 5′ 9″?

Draw circles with these diameters:

20. 4″
21. $4\frac{1}{2}$″
22. $3\frac{1}{4}$″
23. $3\frac{3}{4}$″
24. $2\frac{1}{4}$″

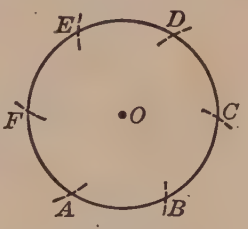
25. In geometry, two circles which cut into each other, as in this picture, are said to **intersect each other**. In this case, you can speak of the two circles as C and C' (read "C-prime"). Draw a figure like this, using a radius of $1\frac{3}{4}$″ for circle C and $1\frac{1}{4}$″ for circle C'.



26. With a radius of $1\frac{1}{2}$″ draw a circle C, and with a radius of $\frac{7}{8}$″ draw a circle C' just touching circle C.

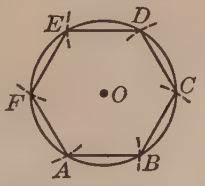
27. Using the same center for both, draw one circle with a radius of $1\frac{3}{4}$″ and another with a radius half as long.

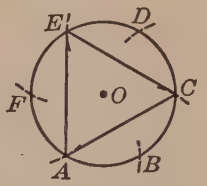
THIS figure shows an interesting and useful fact about a circle. If, after drawing a circle, you keep the compasses set to the radius that you have used, **you can step around the circle with the compasses exactly six times.**



That is, as shown in this figure, if you start at any point *A*, you will come back exactly to *A* on the sixth step. You must, of course, **be careful not to change the setting of the compasses.**

If you now draw straight lines from *A* to *B*, from *B* to *C*, and so on, you will have a **regular hexagon** inside the circle, as shown in the first of these figures. If you draw only *AC*, *CE*, and *EA*, as shown in the second, you will have an **equilateral triangle.**





You can make a **six-pointed star** by drawing an equilateral triangle *ACE*, as shown in the second figure, and then drawing *BD*, *DF*, and *FB*.

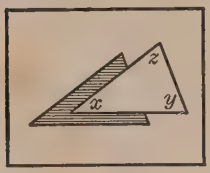
1. Draw a circle with a diameter of about 3 in. and then draw a regular hexagon inside the circle.

2. Draw an equilateral triangle inside a circle.

3. Draw a six-pointed star inside a circle and erase the circle after you have finished.

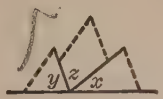
4. Draw a regular hexagon inside a circle, erase the circle, and extend all the sides of the hexagon until they meet. What kind of figure is formed?

THE figures below illustrate an important fact about triangles. If you will experiment with triangles cut out of paper, as suggested, you can discover this fact for yourself.



Cut a triangle out of paper

Cut off the three angles



Put the angles together

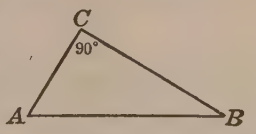
1. Draw a horizontal line and then draw a line meeting it at right angles at a point P. How many degrees are there in 2 right angles? How many degrees are there on each side of the horizontal line at P? How many degrees are there in the sum of the angles as placed in the third figure, above?

2. Cut out four triangles of different shapes, cut off the three angles in each case, and see if their sum is always the same.

The sum of the angles of a triangle is 180°.

3. Find the size of the third angle of a triangle in which two of the angles contain 20° and 30°; 45° and 45°; 37° and 48°.

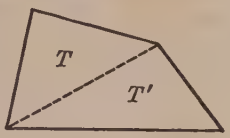
4. A **right triangle**, as the name suggests, is one in which one of the angles contains 90°. How many degrees are there in the sum of the other two angles?



5. Read and complete this statement: **The sum of the acute angles of a right triangle is —— degrees.**

THE name **quadrilateral** is given to **any figure formed by four straight lines which meet.** Squares, rectangles, and parallelograms are all quadrilaterals. Here are five others:

Any quadrilateral can be divided into two triangles by drawing a **diagonal**, as shown in this figure. How many degrees are there in the sum of the angles of each triangle? How can you then tell how many degrees there are in the sum of the angles of the quadrilateral?



1. In the last quadrilateral above, what is the sum of the angles in T? in T'? in $T + T'$? in the whole quadrilateral?

2. Copy free-hand the five quadrilaterals shown at the top of the page, draw a diagonal in each, and show that the sum found in Ex. 1 is the same for all the quadrilaterals.

The sum of the angles of a quadrilateral is 360°.

3. If a quadrilateral has three right angles, what is the size of the other angle? Why?

4. In dividing a quadrilateral into two triangles in order to find the sum of the angles, does it make any difference which diagonal you draw? Explain your answer.

5. Read and complete this statement: **The sum of the angles of a quadrilateral is equal to —— right angles.**

IN MEASURING fields and in drawing plans, surveyors often use the facts which you have just learned about the sums of angles. For example, suppose that a surveyor's measurements show that the angles of a four-sided field are respectively 77° 25′, 93° 36′, 82° 45′, and 104° 40′. Adding, as here shown, he finds that the sum is 358° 26′. Since he knows that the **sum of the angles should be 360°,** he can tell that there is an error of 1° 34′ in his work.

77° 25′
93 36
82 45
104 40
358° 26′

Find the third angle of a triangle in which two are angles of

1. 48° 18′ and 63° 14′
2. 67° 28′ and 72° 39′
3. 82° 1′ and 43° 0′
4. 112° 28′ and 34° 32′

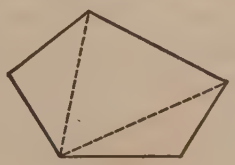
Find the other acute angle of a right triangle in which one is an angle of

5. 28° 33′
6. 42° 28′
7. 60° 0′
8. 72° 59′

Find the fourth angle of a quadrilateral in which three of the angles are angles of

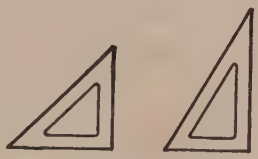
9. 27° 13′, 42° 36′, 94° 7′
10. 84° 2′, 78° 9′, 98° 17′

11. Here is a pentagon that has been divided into triangles by drawing two diagonals. What is the sum of the angles in each triangle? What is the sum of all the angles of the pentagon?

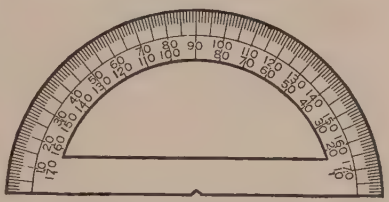


12. Find the size of the fifth angle of a pentagon in which four of the angles are angles of 108° each.

DRAFTSMEN who have to make careful scale drawings use other instruments besides the ruler and compasses. Among these are **triangles** and the **protractor.** The triangles are often made of transparent material and they usually have the shapes here shown. The first triangle has two acute angles of 45° each, and the second has acute angles of 30° and 60°.



The protractor, of which a common type is pictured below, is used for drawing and measuring angles. If you have a protractor, you can easily learn how it is used. Be sure to place the center notch of the protractor exactly at the vertex of the angle and the lower edge along one of the sides. You can then easily read the size of the angle.

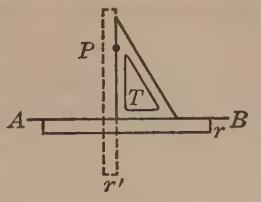


1. Draw four triangles shaped like these, but about three times as large. Using a protractor, measure each angle and find their sum for each triangle. What should this sum be?

2. After redrawing the figures below, as in Ex. 1, measure the angles of the figures and find their sum in each case:

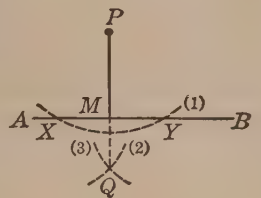
Drawing Perpendiculars

IN DRAWING **a perpendicular from a point *P* to a line *AB*,** you can use **a ruler and triangle,** as here shown. Place the edge of the ruler *r* along *AB* and slide the triangle *T* along the ruler until one side of the right angle passes through *P*. Then move the ruler to the position *r'*, as shown by the dotted lines, take away the triangle, and draw the perpendicular.



Accuracy is just as important in drawing geometric figures as in adding, subtracting, multiplying, and dividing.

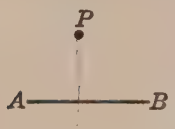
Another way of drawing a perpendicular from *P* to *AB* uses **a ruler and compasses.** With *P* as center and any convenient radius, draw arc (1) cutting *AB* at points which you may call *X* and *Y*. Using first *X* and then *Y* as centers and the same radius for both, draw arcs (2) and (3). Now draw *PQ*, which will cut *AB* at some point, as *M*. Then *PM* is perpendicular to *AB*.



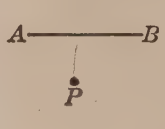
The arcs (1), (2), and (3) are used only to help in drawing, or constructing, the perpendicular *PM*. Such lines are often called **construction lines,** and are shown as dotted lines.

Draw perpendiculars to lines in these positions, using the first method in Exs. 1 and 2 and the second in Exs. 3 and 4:

1.

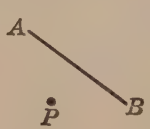


2.

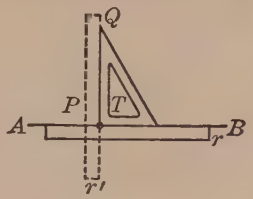


3.

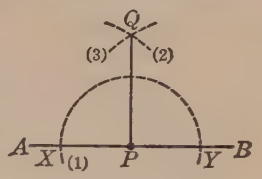
4.



ON PAGE 218, the point P was outside the line AB in both cases. If the point lies on the line, **a ruler and triangle** can be used as here shown. Simply place the ruler r along the line AB and then slide the triangle T along the ruler r until the vertex of the right angle is at P. Then move the ruler to the position r', as shown by the dotted lines, take away the triangle, and draw PQ.



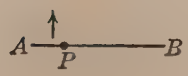
In using **a ruler and compasses** for drawing a perpendicular to a line AB at a point P on the line, you can use the method here shown. This is so nearly like the method on page 218 that you will easily understand it from the figure. The three arcs are numbered, as before, in the order drawn, and the construction lines are shown as dotted lines.



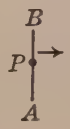
1. In the second case, what center was used for arc (1)?
2. At what points does arc (1) cut the line AB?
3. What center was used for arc (2)? for arc (3)?
4. How was the point Q found? How was PQ drawn?

Draw perpendiculars to lines in these positions, using the first method in Exs. 5 and 6 and the second in Exs. 7 and 8:

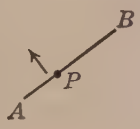
5.



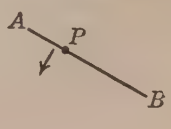
6.



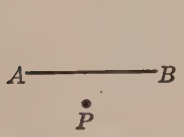
7.

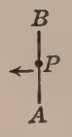


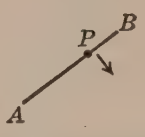
8.

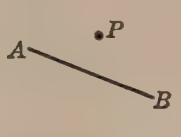


Using any method that you wish, draw through P a perpendicular to the line AB in each of the following positions:

1. 

2. 

3. 

4. 

Draw a right angle in each of the following positions:

5.

6.

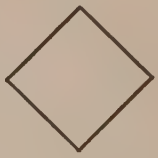
7.

8.

Using any method that you wish, copy each of these figures, making each line twice as long as here shown:

9.

10.

11. 

12.

13. Draw a right triangle in which the sides of the right angle are 3 in. and 4 in. Find the third side by measuring.

14. Draw an isosceles triangle in which each of the equal sides is about 2 in. long, and draw a perpendicular from the vertex formed by these sides to the third side.

15. Draw a triangle in which all the angles are acute, and from each vertex draw a perpendicular to the opposite side.

Do these additions and subtractions:

1.	2.	3.	4.	5.
7979	5148	3735	1920	122.2
5666	7687	4560	114	141.4
7498	2869	5459	8452	351.3
8897	8788	4280	320	313.0
+ 6977	+ 3958	+ 4097	+ 1000	+ 703.9

6.	7.	8.	9.	10.
8720	7010	9.137	632.1	70.63
− 1496	− 6987	− 7.833	− 468.7	− 39.89

11. Multiply \$42.34 by 120; 5280 ft. by 23

12. Divide \$2265.76 by 476; \$1075 by 1.25

Copy in columns and then find the sums:

13. $2\frac{3}{4} + 6\frac{7}{8} + 1\frac{1}{2}$

14. $1\frac{2}{3} + 3\frac{2}{3} + \frac{5}{12}$

15. $2.34 + 0.72 + 1.09$

16. $0.726 + 0.438 + 4.000$

Find the differences:

17. $4\frac{3}{8} - 2\frac{1}{4}$

18. $3\frac{1}{2} - 1\frac{5}{8}$

19. $6 - 3\frac{7}{8}$

20. $5\frac{4}{5} - 3$

21. $7\frac{2}{3} - 1\frac{1}{4}$

22. $3\frac{1}{5} - 2\frac{3}{4}$

Find the products:

23. $1\frac{1}{2} \times 2\frac{3}{4}$

24. 2.3×0.7

25. 3.48×6

26. 9×0.09

27. 5.75×2.8

28. 4.3×0.072

Find the quotients:

29. $5\frac{1}{8} \div 2$

30. $3 \div 4\frac{2}{3}$

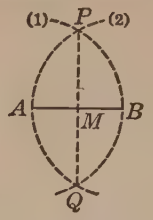
31. $2.4 \div 0.8$

32. $6.3 \div 0.21$

33. $5\% \div 2\frac{1}{2}\%$

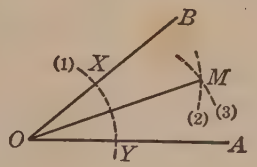
34. $420 \div 2.10$

THE first figure below shows how to **bisect the line *AB***, which means **to divide it into two equal parts.** As shown, arcs (1) and (2), which meet each other at *P* and *Q*, are drawn with *A* and *B* as centers and the same radius *AB*. The line *PQ*, cutting *AB* at *M*, is then drawn. The point *M*, which is called the **midpoint** of *AB*, bisects *AB*.



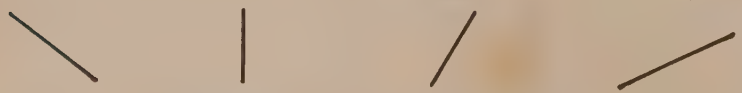
In what way is this method of bisecting a line like one method of drawing a perpendicular?

This figure shows how to draw the line *OM* so as to **bisect the angle *AOB*.** Any convenient radius may be used for arc (1), which is drawn with *O* as center. Arcs (2) and (3), which meet at *M*, are drawn with *X* and *Y* as centers and the same radius. The line *OM* is then drawn from *O* to *M*.



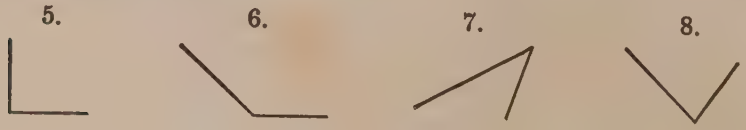
Using a ruler, draw longer lines in these positions, and then bisect each one by the method given above:

1. 2. 3. 4.



Copy these angles, making the sides at least twice as long as here shown, and then bisect each angle:

5. 6. 7. 8.



YOU have learned enough about using the ruler, compasses, and right triangle so that you can now have some fun in making geometric designs. **Draw as neatly as you can,** and erase the construction lines if your teacher tells you to do so.

Copy these designs, making each figure at least twice as large as the size shown below:

1.

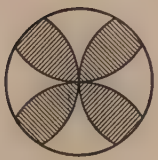
2.

3.

4.

5.

6.

7. 

8.

9.

10. Draw a circle about 2 in. in diameter, and in it draw some design, different from the ones shown above, that you think is pretty. If you have colored crayons, try coloring various parts of the design.

1. Snowflakes are always hexagonal in shape, and under the magnifying glass they show many different and beautiful geometric designs. Draw a regular hexagon inside a circle in the way that you have already learned, and then divide it into six equilateral triangles by drawing three diagonals.

2. Draw a regular hexagon, and decorate it as nearly as you can like the first snowflake shown above.

3. Which of the three snowflakes do you think is the most beautiful? Draw a hexagonal design which you think is pretty.

4. See how many different geometric figures you can name in the picture of the snowflakes.

Copy these designs, using in each case a circle 2 in. in diameter, and then erase your construction lines:

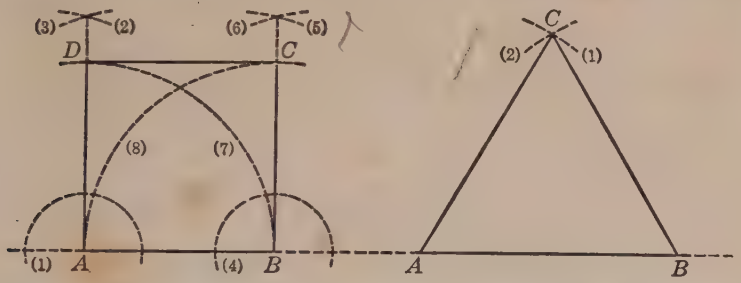
5.

6.

7.

8. Did you ever see any of the designs that frost makes on a windowpane? Sometimes they are very beautiful. Tell the class about them if you can.

IT IS easy to draw a square and an equilateral triangle with a ruler and compasses, as shown below. For the square, simply draw perpendiculars at A and B, making AB the length



you want for the side. Then using A and B as centers and AB as the radius, locate D and C by arcs, and draw DC.

It is even easier to draw an equilateral triangle. Start with one side AB, and with A and B as centers and AB as the radius, draw arcs meeting at C. Draw AC and BC.

---

1. How do you know that $AD = AB$ and that $AD = BC$ in the square? that $AB = BC = AC$ in the triangle?

Draw a square in which each side is

2. 2 in. **3.** $2\frac{1}{2}$ in. **4.** $3\frac{1}{4}$ in. **5.** $1\frac{7}{8}$ in. **6.** 1.5 in.

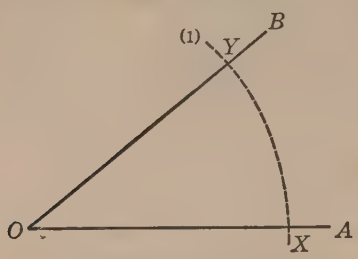
Draw an equilateral triangle in which each side is

7. $1\frac{1}{2}$ in. **8.** $2\frac{1}{4}$ in. **9.** $2\frac{5}{8}$ in. **10.** $3\frac{1}{8}$ in. **11.** 1.25 in.

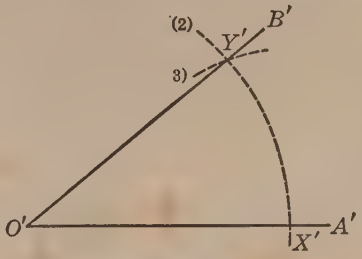
12. Draw an equilateral triangle 2 in. on a side, and bisect each of the angles. How do the bisectors of the angles meet?

13. Draw another equilateral triangle 2 in. on a side, and bisect each side. How do the bisectors of the sides meet?

IT IS often necessary to **draw an angle that will be equal to a given angle.** You could, of course, do this with a protractor, or you can use a ruler and compasses as shown below.



Given angle *AOB*



Equal angle *A′O′B′*

Starting with the vertex *O* as center and any convenient radius, draw arc (1) cutting *OA* at *X* and *OB* at *Y*.

Now draw a straight line about as long as *OA* and call it *O′A′* (read "*O*-prime *A*-prime"). With *O′* as center and the same radius used for arc (1), draw arc (2), thus locating the point *X′*.

Now place one point of the compasses on *X* and the other on *Y*, and with this radius and *X′* as center, draw arc (3), cutting arc (2) at *Y′* as shown.

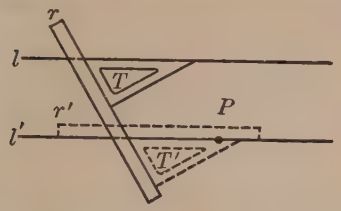
Laying your ruler on *O′* and *Y′*, draw the line *O′B′*. The angle *A′O′B′* thus formed is equal to the given angle *AOB*.

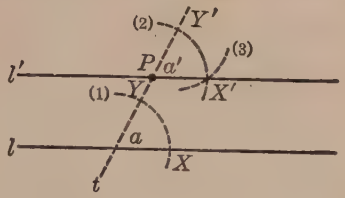
Draw five angles of different sizes, calling them AOB, COD, EOF, GOH, and IOJ, and then draw an angle equal to angle

1. *AOB* 2. *COD* 3. *EOF* 4. *GOH* 5. *IOJ*

6. Draw an angle *AOB*, making the side *OA* about 2 in. long. At *A* draw an angle equal to angle *O*, and extend the side of angle *A* to meet *OB*. What kind of triangle have you?

THERE are several ways of **drawing one line parallel to another.** The first figure shows how the line l' can be drawn through P parallel to l with **a ruler and triangle.** The dotted

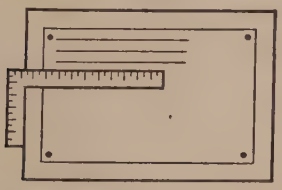


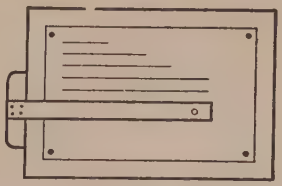


lines show how the triangle T is moved along the ruler r to the position T' where its side passes through P. The ruler is then moved to the position r', and l' is drawn along it.

The second figure shows how to draw the line l' through P parallel to l by using **a ruler and compasses.** The line t is first drawn, making any angle a with l. The line l' is then drawn as the other side of the angle a', which is made equal to angle a by the method described on page 226.

Other common methods of drawing parallels are shown in the pictures below. The first one shows how a **carpenter's**



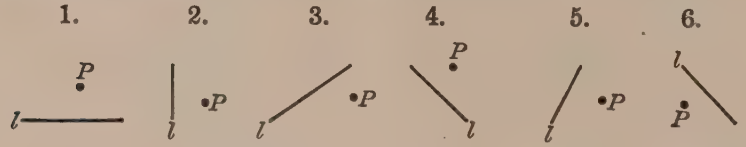


square can be used against the edge of a drawing board, and the second shows how the instrument called a **T-square** is similarly used.

In drawing parallels, use the method that you find most convenient unless your teacher tells you to use some special one.

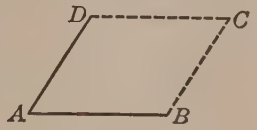
Drawing Exercise

Draw six lines l, each about 3 in. long, in these positions, and mark a point P about 1 in. from each line as shown. In each case, then draw through P a line l' that will be parallel to l:

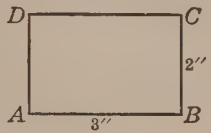


7. Draw a horizontal line AB about 3 in. long. Then draw two lines parallel to AB, one $1\frac{1}{2}$ in. above it and the other 2 in. below it.

8. Draw two lines AB and AD meeting at A, as shown in this figure. Make your figure much larger. Then draw DC parallel to AB, as shown by the dotted line, and draw BC parallel to AD, thus completing the parallelogram $ABCD$.



9. Draw a rectangle $ABCD$ 3 in. long and 2 in. wide by first drawing a 3-inch line AB. How can you then draw AD perpendicular to AB at A? How can you then locate D? How can you then finish the work?



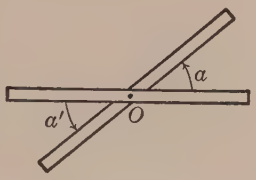
As in Ex. 9, draw a rectangle with the following dimensions:

10. $3\frac{1}{2}$ in., $1\frac{3}{4}$ in. 11. $2\frac{7}{8}$ in., 3 in. 12. 2 in., 2 in.

13. Draw a square 2 in. on a side, and then draw a line parallel to the base and 1 in. above it.

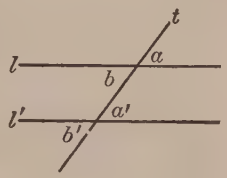
14. Draw an equilateral triangle 2 in. on a side, bisect one of the sides, and through this midpoint draw lines parallel to the other two sides of the triangle.

THERE are several interesting and useful facts about the angles formed when straight lines intersect. If, as here shown, you put a pin O through two strips of cardboard, you can open and close them like a pair of scissors. As you open them, you will notice that the angle marked a grows larger just as fast as the angle opposite it, marked a'. These angles are called **vertically opposite angles.**



If two straight lines intersect, the vertically opposite angles are equal.

This picture shows two parallel lines l and l' cut by a third line t, called a **transversal.** What do you know about the angles a and b? There are other pairs of equal angles. The angles a and a', which are called **corresponding angles, are always equal.** The corresponding angles b and b' are also always equal.



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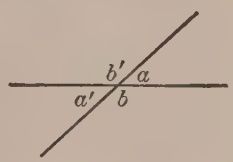
1. If $a = 57°$ in the last figure above, what is the size of angle b? of angle a'? of angle b'?

2. Name the pairs of equal angles in the figure below.

3. In Ex. 2, if $a = 37\frac{1}{2}°$, what is the size of angle a'?

4. If $b = 142\frac{1}{2}°$, what is the size of b'?

5. From Exs. 3 and 4, what is the sum of angles a, a', b, and b'?



6. Read and complete this statement: **The number of degrees around a point is ——.**

IF THE sum of two angles is 90°, each angle is called the **complement** of the other. For example, in the first two right angles below, a and b are complements of each other.

The third figure above shows that angles of 30° and 60° are complementary. What does the fourth right angle show?

The figures below show other angles. If the sum of two angles is 180°, each is called the **supplement** of the other.

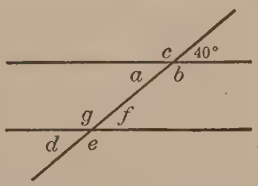
1. The complement of an angle of 30° contains 90° − 30°, or 60°. What is the size of the complement of an angle of 45°?

2. The supplement of an angle of 30° contains 180° − 30°, or 150°. What is the size of the supplement of an angle of 45°?

3. Find the complement of an angle of 10°; of 60°; of 89°.

4. Find the supplement of an angle of 65°; of 130°; of 1°.

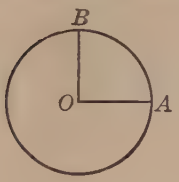
5. This figure shows two parallel lines cut by a third line. How large is the angle vertically opposite to angle a? What is the size of angle a?

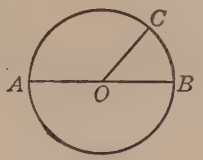


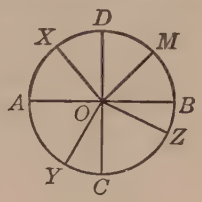
From what you have learned about angles, you can now find the sizes of all the angles in the figure. Find the number of degrees in angle

6. b **7.** e **8.** g **9.** d **10.** f **11.** c

YOU already know that **arcs, like angles, are measured in degrees and there are 360° in a circle.** This page gives some other facts about angles and arcs that you should know.







1. In the first figure, arc AB is one fourth of the circle and angle AOB is a right angle. How many degrees are there in arc AB? How many degrees are there in angle AOB?

Name the part of a circle that is an arc of

2. 180° 3. 45° 4. 15° 5. 30° 6. 135°

7. An angle at the center of a circle, like angle AOB in the first figure, is called a **central angle. The number of degrees in a central angle is the same as the number of degrees in its arc.** If arc BC in the second figure contains 50°, what is the size of angle BOC?

8. How many degrees are there in a semicircle? In the second figure, what is the size of arc CA? of angle COA?

In the third figure above, angle $BOD = 90°$, angle $BOM = 45°$, angle $XOC = 140°$, angle $AOY = 60°$, angle $YOC = 30°$, and angle $COZ = 65°$. Find the size of

9. Angle MOA 12. Angle XOA 15. Arc XY
10. Angle DOX 13. Angle ZOB 16. Arc ZB
11. Angle YOZ 14. Angle BOX 17. Arc ZM

DID you ever use a compass? Here is a picture of a small pocket compass such as Boy Scouts often carry. The four principal directions, as you probably know already, are **north (N.), south (S.), east (E.),** and **west (W.).**

The needle on a compass always points to the north, so that by looking at it you can always tell which direction is north.

1. The direction **northeast (N. E.)** means 45° east of north. Study the compass and tell the meaning of **southeast (S. E.), southwest (S. W.),** and **northwest (N. W.).**

2. The dotted line on this map shows the route some Boy Scouts took on a hike. From *A* to *B* they went along the road in the direction northeast. What was the direction of the road they took from *B* to *C*?

Study the map and from it state the approximate direction of

3. The creek from the bridge at *C* to the bend at *D*.

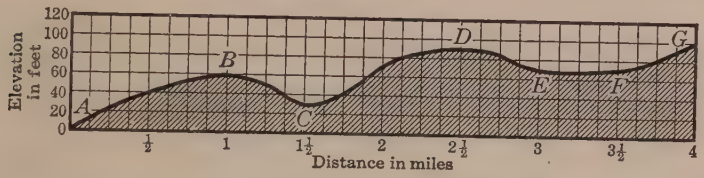
4. The creek from *D* to *E*, where the boys left the creek.

5. Their route from *E* to the large rock at *F*.

6. Their route from *F* to *G*; from *G* to the big oak at *H*.

7. The shortest route from *J*, where the boys stopped to look at their compass, to the road *AB*.

1. This picture, which is called a **profile map**, shows how a road rises and falls from sea level (0 ft.) at A to an elevation

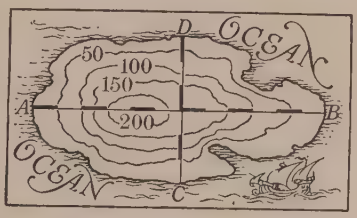


of 100 ft. above sea level at G. The hills are not really as steep as shown, because each horizontal space represents 660 ft., while each vertical space represents 20 ft. From A to B, the distance measured horizontally is 1 mi. (5280 ft.). How many feet does the road rise in this distance?

2. The **grade of a road** is usually expressed as a per cent, a grade of 1% meaning a rise of 1 ft. in each 100 ft. measured horizontally. In Ex. 1, what is the grade, to the nearest 0.1%, from A to B? from C halfway to D? from F to G?

3. Draw a profile map of a road AG in which the elevations at points $\frac{1}{2}$ mi. apart are as follows: A, 0 ft.; B, 20 ft.; C, 40 ft.; D, 90 ft.; E, 50 ft.; F, 30 ft.; G, 20 ft.

4. This picture, which is called a **contour map**, is drawn to the scale of 1 in. to 8 mi. It shows an island 12 mi. long and 6 mi. wide. From A to B the land rises 50 ft. in the first mile, 50 ft. more in the second, and 100 ft. more in the third, where it reaches the highest elevation (200 ft.). From there the land runs level (or approximately so) for $2\frac{1}{2}$ mi., where it begins to slope down to the sea. Draw a profile map of the island from A to B; from C to D.



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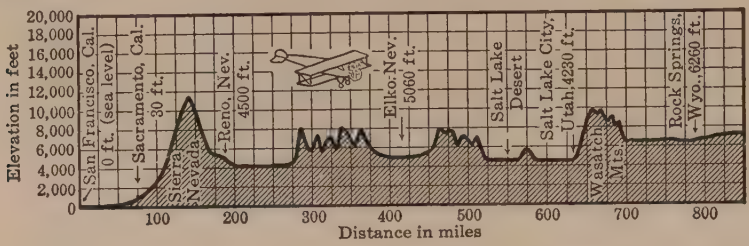
1. This profile map of part of the airplane route from San Francisco to Chicago shows the mountains over which the



planes must fly. As in the diagram on page 233, the mountains are not really as steep as here shown, since each vertical space represents 2000 ft. and each horizontal space represents 25 mi. How many feet does each horizontal space represent?

2. What is the name of the highest mountain range shown on the map? What is the approximate height?

3. The highest part of the Sierra Nevada is about how many miles from San Francisco?

4. After leaving San Francisco, about how many feet per mile does an aviator have to rise in order to gain sufficient height to cross the Sierra Nevada?

5. The elevation of Elko, Nevada, is how much more than that of Reno, Nevada? of Salt Lake City, Utah?

6. After leaving Salt Lake City, about how many feet does an aviator have to rise in order to gain sufficient height to cross the Wasatch Mountains?

7. The height of the Wasatch Mountains is how much less than that of the Sierra Nevada? Their height is what per cent of that of the Sierra Nevada?

8. San Francisco and Chicago are 1915 mi. apart by the route shown in the map on the opposite page. At an average rate of 120 mi. per hour, how many hours and minutes, actual flying time, will it take for a plane to cover the distance between these two cities?

9. Omaha, one of the stopping places on the route, is 430 mi. from Chicago. At Omaha, what per cent of the distance from Chicago to San Francisco (Ex. 8) has been covered?

10. A recent speed record for airplanes is 328.63 mi. per hour. If a plane could keep up this rate, how long would it take to fly from Chicago to San Francisco (Ex. 8)?

11. The rate in Ex. 10 is how many times faster than that of two aviators who covered the 240 mi. from Washington to New York in 1 hr. 10 min., actual flying time?

12. When an airplane makes an 880-mile trip from Chicago to New Orleans in 7 hr. 20 min., actual flying time, what is the average rate per hour?

13. One month 104.88 T. of air mail were carried on one of the important mail routes. The next month, after the postal rates were lowered, the amount of mail increased 50%. How many tons were carried the second month?

14. One air route from Chicago to St. Louis is 269 mi. long, and the fare is $40. How much is this per mile?

15. On a trip from Newfoundland across the Atlantic Ocean, Europe, and Asia to Tokyo, Japan, an airplane covered the distance of 12,295 mi. in 145 hr. 30 min., actual flying time. What was the average rate per hour?

Test on Geometric Facts

Write the numbers 1 to 12 on your paper, and after each write the letter indicating the expression in the parentheses that you think is best for completing the statement:

1. In a rectangle the number of right angles is (*a*. 2. *b*. 4. *c*. 360°. *d*. 180°).

2. The opposite sides of a parallelogram are equal and (*a*. horizontal. *b*. vertical. *c*. slanting. *d*. parallel).

3. The diameter of a semicircle is (*a*. half the circumference. *b*. its base. *c*. twice the radius. *d*. a curve line).

4. In a square the four sides are (*a*. parallel. *b*. equal. *c*. horizontal. *d*. complementary).

5. If you cut straight across the common type of cylinder, you will have a (*a*. parallelogram. *b*. circle. *c*. square. *d*. semicircle).

6. The number of faces which a square pyramid has is (*a*. 4. *b*. 3. *c*. 6. *d*. 5).

7. The sum of the angles of a triangle is (*a*. 3. *b*. 360°. *c*. 180°. *d*. 90°).

8. The shortest path between two points is a (*a*. curve. *b*. broken line. *c*. straight line. *d*. perpendicular).

9. The number of edges which a cube has is (*a*. 12. *b*. 4. *c*. 6. *d*. 8).

10. The area of a rectangle is the product of the base and the (*a*. height. *b*. perimeter. *c*. opposite side. *d*. diagonal).

11. In the common type of cone the base is a (*a*. pentagon. *b*. rectangle. *c*. circle. *d*. straight line).

12. The number of faces which a hexagonal prism has is (*a*. 6. *b*. 8. *c*. 12. *d*. 7).

Review Practice

See how quickly you can do these examples:

1.	2.	3.	4.	5.
987	7502	\$98.98	6.45	8.875
876	4391	6.75	9.18	.032
765	6284	25.50	4.06	6.540
+ 654	+ 9109	+ 11.26	+ .29	+ 7.509

6.	7.	8.	9.	10.
547	6542	\$75.25	3.98	468.9
− 398	− 975	− 62.98	− 2.09	− 279.8

See how quickly you can do these multiplications:

11. 27×642 13. $17\frac{1}{2} \times 350\frac{2}{3}$ 15. 1.075×12.8
12. 215×394 14. $0.375 \times \$84$ 16. $0.98 \times 0.95 \times 15$

See how quickly you can do these divisions:

17. $768 \div 15$ 19. $25\frac{1}{2} \div 1\frac{1}{4}$ 21. $60.75 \div 0.375$
18. $484 \div 3\frac{1}{7}$ 20. $\$979 \div 2.75$ 22. $132.24 \div 4.64$

Find these per cents:

23. 25% of \$136
24. $37\frac{1}{2}$% of \$824
25. 93.5% of \$420
26. 62% of 750 ft.
27. 1.35% of 528 lb.
28. $98\frac{1}{2}$% of 246 cu. in.

Find the missing numbers:

29. 15% of \$5 is \$—
30. —% of \$50 is \$10
31. 24% of — is 76.2
32. 15 ft. is 12% of — ft.
33. — lb. is 15% of $62\frac{1}{2}$ lb.
34. 254 in. is —% of 762 in.

HERE are some problems that will help you to learn to think straight. Some of them cannot be solved because not enough is given; in others more is given than you will need to use in solving them.

Solve as many of these problems as you can and tell why the others cannot be solved:

1. Helen bought 3 balls of yarn for $1.20. How much did each one cost?

2. Helen also paid $1.60 for some towels. How much did each one cost?

3. Mrs. Nye bought 3 boxes of soap, each containing 1 doz. cakes, for $4.05. How much did each box cost?

4. At 8¢ a pound, how much will 1120 nails cost?

5. Tom measured the sides of a triangular flower bed in the park. The first side was $14\frac{1}{2}$ ft. long and the second was $12\frac{1}{4}$ ft. long. How far was it around the bed?

6. Jim counted the swings of the pendulum in the hall clock. He found that it made 25 swings in $17\frac{1}{2}$ sec. Each swing took what fraction of a second?

7. For her Halloween costume, Jane bought 7 yd. of yellow cheesecloth at 11¢ a yard and 3 yd. of black ribbon at 9¢ a yard. How much did the cheesecloth cost?

8. There are 160 sq. rd. in an acre. What are the dimensions of a rectangular field that contains 10 A.?

9. A grocer who made a profit of 10% on the selling price sold some canned goods for which he paid $2.40 per dozen at 40% more than cost. What was the selling price per can?

Tell how you would solve each of these problems if the numbers that belong in the blank spaces were given:

1. There are —— persons in the Hoyt family. Mrs. Hoyt spends an average of $—— per week for food. What is the average weekly cost per person?

2. A salesman works on a commission of ——%. How much commission does he earn on a sale amounting to $——?

3. What is the perimeter of an equilateral triangle in which each side is —— in. long?

4. At ——¢ per hour, how much does it cost per week for the electricity for an electric flatiron that is used an average of —— hr. —— min. per week?

5. Mr. Brown bought a rectangular field that adjoined his farm. The field was —— rd. long and —— rd. wide. How many acres did he buy?

6. At a bargain sale, Mrs. Nye paid $—— for a coat that had been originally marked $——. At what per cent off was the coat sold?

7. A dealer pays $—— apiece for some chairs which he sells at $—— each. If the allowance for overhead expenses is $—— per chair, how much profit does he make per chair?

8. A map is drawn to the scale of —— in. to —— mi. What distance on the map represents a distance of —— mi.?

9. Jack bought —— doz. lemons at ——¢ per dozen. How much change did he get from $——?

10. Alice is measuring the angles of a triangle. The first one contains ——° and the second ——°. How many degrees should she find that the third angle contains?

1. As a boy, Abraham Lincoln had to work hard to earn money for his clothes and books. He once split 1400 rails to pay for $3\frac{1}{2}$ yd. of brown jean for trousers. How many rails did he have to split to pay for 1 yd.?

2. Lincoln's father sold a 200-acre farm for $20 in cash and $300 in trade. What price per acre did his father receive?

3. Lincoln worked on a flatboat on the Ohio River at $6 per month. When his pay was raised to $8.50 per month, what per cent was it increased?

4. On one river trip of 6 wk., Lincoln received 50¢ a day and $20 at the end of the trip. How much was this per week?

5. When Lincoln was 20 yr. old, his family moved from Indiana to Illinois. It took them 2 wk. to travel the 190 mi. How many miles did they average per day? At 26.5 mi. per hour, how long does it take today to drive 190 mi.?

6. Before starting on the trip in Ex. 5, Lincoln spent his savings of $30 for a stock of knives, forks, needles, and the like, to sell on the way. He sold them for 100% more than they cost. How much did he receive?

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. When 1200 bu. of corn are produced from a 25-acre field, what is the average yield per square rod? (1 A. = 160 sq. rd.)

2. Mrs. Kane paid \$2.76 for a roast of beef that weighed $5\frac{3}{4}$ lb. How much per pound did she pay for it?

3. In a rectangle 60 ft. long and 40 ft. wide, the width is what per cent of the length?

4. At 8¢ a mile, how much will a traveling salesman receive for car expenses in a month in which he drives 1140 mi.?

5. Mr. Brown bought for \$22.05 an overcoat marked \$27. At what per cent of discount did he buy it?

6. A 12-acre rice field yielded 10.8 T. of rice. At 45 lb. to the bushel, how many bushels per acre was this?

7. What is the perimeter of (the distance around) a regular hexagon in which each side is $6\frac{7}{8}$ in. long.?

8. The area of a 2-inch square is what per cent of the area of a rectangle twice as long and half as wide as the square?

9. How much money must be invested at 5% to yield an income of \$150 every 6 mo.?

10. In a recent year there were 3,066,000 passenger automobiles manufactured in the United States, and 2,452,800 of these were closed cars. Find the per cent of closed cars.

Test on Business Procedure

Write the numbers 1 to 10 on your paper, and after each write the letter indicating the expression in the parentheses that you think is best for completing the statement:

1. In a store, the price placed on an article is called the (*a.* marked price. *b.* invoice. *c.* overhead. *d.* sales slip).

2. When interest is compounded, it is added to the (*a.* paid checks. *b.* balance on deposit. *c.* discount. *d.* deposit slip).

3. The amount left after paying the commission on a sale is called the (*a.* principal. *b.* trade discount. *c.* invoice cost. *d.* proceeds).

4. When a bank pays one of its depositor's checks, it charges the amount to (*a.* overhead expense. *b.* the payee's dividends. *c.* the depositor's account. *d.* the paying teller).

5. The amount of an invoice after taking off the discount is called the (*a.* proceeds. *b.* net amount. *c.* trade discount. *d.* markdown price).

6. If you indorse a promissory note, you agree to pay it in case the (*a.* bank fails. *b.* note is discounted. *c.* maker does not. *d.* proceeds are large enough).

7. The expenses of running a store are called the (*a.* margin. *b.* net amount. *c.* overhead. *d.* commission).

8. In borrowing money, the amount borrowed is called the (*a.* premium. *b.* net amount. *c.* proceeds. *d.* principal).

9. The amount paid for insuring a house against fire is called the (*a.* premium. *b.* face. *c.* proceeds. *d.* discount).

10. When a corporation distributes its profits among the stockholders, it (*a.* cancels its notes. *b.* sells more stock. *c.* charges interest in advance. *d.* pays a dividend).

See how quickly you can add and check:

1.	2.	3.	4.	5.
194	487	720	$1.65	$4.89
365	321	262	4.47	8.37
286	716	976	9.32	5.78
732	142	141	9.53	6.14
528	598	659	5.39	5.25
107	839	978	7.67	2.87

See how quickly you can subtract and check:

6.	7.	8.	9.	10.
8572	9465	6847	9640	$93.38
4989	8487	3968	5674	68.59

11.	12.	13.	14.	15.
8456	8654	6346	9004	$83.42
6987	2976	5789	3485	34.56

Multiply, and then check by going over your work:

16.	17.	18.	19.	20.
749	618	804	259	$8.69
27	75	64	35	98

21.	22.	23.	24.	25.
705	754	743	861	$9.03
46	89	53	23	64

Copy, divide, and then check by multiplication:

26. $92\overline{)25,208}$	31. $37\overline{)19,906}$	36. $79\overline{)14,773}$
27. $62\overline{)18,910}$	32. $84\overline{)20,412}$	37. $53\overline{)21,836}$
28. $48\overline{)27,264}$	33. $69\overline{)28,704}$	38. $78\overline{)20,592}$
29. $65\overline{)12,155}$	34. $56\overline{)16,576}$	39. $73\overline{)66,211}$
30. $31\overline{)21,359}$	35. $29\overline{)20,242}$	40. $59\overline{)29,677}$

The World Sets Our Table

CHAPTER FIVE

PROBLEMS ABOUT GREAT AMERICAN INDUSTRIES

I. OUR FOOD SUPPLY

Where Food Comes From

LAST summer Tom and some other boys were camping at Clear Lake. They caught fish every day, and bought milk and fresh vegetables from the farmers who lived nearby. The rest of their food came from the stores in the town.

One day at dinner the boys tried to guess from what part of our country or the world the different kinds of food that were on the table originally came. When they could not tell, they looked it up in the big geography in the camp library.

Here is a list of a number of foods. See if you can guess from what part of the world each kind originally came:

1. Milk.	6. Flour.	11. Sugar.	16. Rice.
2. Salt.	7. Oranges.	12. Chicken.	17. Melons.
3. Figs.	8. Pepper.	13. Bananas.	18. Corn meal.
4. Butter.	9. Codfish.	14. Bacon.	19. Olive oil.
5. Oatmeal.	10. Beefsteak.	15. Potatoes.	20. Maple sirup.

1. One day on a hike the boys passed a large **market garden.** The farmer who owned it said that he had just sold 750 lb. of cabbage at $3\frac{1}{2}¢$ a pound. How much did he receive for it?

2. He also sold 68 bags of onions at $98¢$ a bag and 120 boxes of lettuce at $60¢$ a box. How much did he receive for them?

3. The farmer pays $16.50 per hundred for bushel boxes. How much does it cost him for 450 boxes?

4. In watering the garden the farmer's men used 1500 gal. of water one day. At $7\frac{1}{2}$ gal. to the cubic foot, how many cubic feet of water did they use?

5. From $2\frac{3}{4}$ A. of potatoes they got an average of 180 bu. per acre. How many bushels did they raise in all?

6. A commission merchant in the city sold 250 bu. of the potatoes at $90¢$ a bushel. He charged a commission of 10% for making the sale. How much was the commission?

Add, writing the results on folded paper:

1.	2.	3.	4.	5.
\$3.21	\$8.39	9.668	35.87	99.702
4.64	1.44	.994	68.80	6.073
2.90	.38	.830	7.54	3.007
9.83	97.76	7.599	52.64	.271
.75	6.57	6.780	9.55	.187
1.60	7.30	.980	81.25	9.978
.32	50.89	2.365	8.19	.608

See how quickly you can do these subtractions:

6.	7.	8.	9.	10.
\$1.75	\$41.06	3.017	7.531	0.9103
.37	12.98	1.868	.789	.3878

11.	12.	13.	14.	15.
\$5.81	\$75.96	2.000	30.03	1689.4
4.80	73.77	.037	.98	699.8

See how quickly you can do these multiplications:

16.	17.	18.	19.
\$129.43	16.27 ft.	5.036	0.456
26	38	0.45	128

20.	21.	22.	23.
\$410.98	30.48 mi.	8.965	16.203
140	305	679	7.9

See how quickly you can do these divisions:

24. $12\overline{)\$15.24}$	28. $12\overline{)18.24}$	32. $70\overline{)216.30}$
25. $31\overline{)\$64.17}$	29. $42\overline{)103.32}$	33. $2.9\overline{)39.179}$
26. $20\overline{)\$62.40}$	30. $36\overline{)565.2}$	34. $4.8\overline{)59.856}$
27. $30\overline{)\$115.50}$	31. $78\overline{)23.166}$	35. $0.56\overline{)35.1904}$

WHEN you buy vegetables at a store, you are not only **paying the farmer for his work** in raising them, but you are also **paying the storekeeper for his work.** The storekeeper charges enough more than he pays the farmer so that he can pay the running expenses of his store and make a profit.

---

1. Mrs. Bryant paid $2\frac{1}{2}¢$ a pound for some potatoes that she bought at a store. At 60 lb. to the bushel, what price per bushel did she pay the storekeeper?

2. In Ex. 1, the storekeeper paid the farmer 80¢ per bushel for the potatoes. How much was the difference between what Mrs. Bryant paid per bushel and the price the farmer received? What reasons can you give for this difference?

3. One year a farmer received $1.50 per bushel for early potatoes. When Mrs. Bryant bought them at the store, she paid 60¢ per peck. How much more did Mrs. Bryant pay per bushel than the farmer received?

4. In Ex. 3, allowing 15 lb. to the peck, find how much Mrs. Bryant paid per pound.

5. In Ex. 3, Mrs. Bryant paid what per cent more than the farmer received?

6. Mrs. Bryant bought onions at the store for 6¢ a pound. At 57 lb. to the bushel, what rate per bushel was she paying?

7. In Ex. 6, the storekeeper paid the farmer $1.70 per bushel for the onions. Find the difference per bushel between what the farmer received and Mrs. Bryant paid.

8. What reasons can you give for a farmer's preferring to sell vegetables to storekeepers rather than trying to sell them directly to people in the city?

See how quickly you can do these additions:

1. $\frac{1}{2}$	2. $\frac{3}{8}$	3. $\frac{1}{8}$	4. $\frac{5}{16}$	5. $1\frac{1}{2}$	6. $5\frac{3}{8}$
$\frac{1}{8}$	$\frac{1}{2}$	$\frac{3}{16}$	$\frac{1}{2}$	$\frac{3}{4}$	$2\frac{3}{16}$
7. $\frac{3}{4}$	8. $\frac{7}{8}$	9. $\frac{1}{4}$	10. $\frac{1}{2}$	11. 4	12. $5\frac{1}{8}$
$\frac{3}{4}$	$\frac{3}{4}$	$\frac{11}{16}$	$\frac{1}{10}$	$2\frac{1}{4}$	$7\frac{3}{4}$

See how quickly you can do these subtractions:

13. $\frac{3}{16}$	14. $\frac{5}{8}$	15. $\frac{1}{2}$	16. $\frac{3}{4}$	17. 2	18. $3\frac{1}{8}$
$\frac{1}{8}$	$\frac{3}{16}$	$\frac{3}{8}$	$\frac{3}{16}$	$\frac{7}{16}$	$1\frac{1}{2}$
19. $\frac{9}{16}$	20. $\frac{7}{10}$	21. $\frac{1}{2}$	22. $\frac{7}{8}$	23. $8\frac{3}{4}$	24. $8\frac{11}{16}$
$\frac{3}{8}$	$\frac{2}{5}$	$\frac{5}{16}$	$\frac{11}{16}$	5	$5\frac{7}{8}$

See how quickly you can do these multiplications:

25. $\frac{1}{2} \times \frac{3}{4}$	28. $\frac{3}{8} \times \frac{3}{4}$	31. $1\frac{3}{4} \times 2\frac{5}{8}$
26. $\frac{2}{3} \times \frac{1}{2}$	29. $\frac{5}{8} \times \frac{1}{2}$	32. $3\frac{1}{2} \times 5\frac{1}{4}$
27. $\frac{1}{6} \times \frac{2}{3}$	30. $\frac{2}{5} \times \frac{5}{8}$	33. $2\frac{1}{4} \times 3\frac{1}{2}$

34. Taking $2\frac{1}{2}$ and $7\frac{1}{2}$, find both quotients; that is, find the quotient of $2\frac{1}{2} \div 7\frac{1}{2}$ and of $7\frac{1}{2} \div 2\frac{1}{2}$.

For each of the following pairs of fractions, find the sum, the difference, the product, and both quotients:

35. $\frac{1}{2}$, $\frac{1}{4}$	39. $\frac{1}{2}$, $\frac{1}{3}$	43. $\frac{1}{2}$, $\frac{1}{8}$	47. $5\frac{1}{2}$, $3\frac{3}{4}$
36. $\frac{3}{8}$, $\frac{1}{4}$	40. $\frac{7}{8}$, $\frac{1}{2}$	44. $\frac{3}{4}$, $\frac{1}{2}$	48. $6\frac{1}{4}$, $3\frac{1}{2}$
37. $\frac{5}{8}$, $\frac{1}{2}$	41. $\frac{3}{4}$, $\frac{1}{8}$	45. $\frac{7}{8}$, $\frac{1}{4}$	49. $2\frac{3}{16}$, $1\frac{7}{8}$
38. $\frac{7}{8}$, $\frac{3}{4}$	42. $\frac{5}{8}$, $\frac{1}{4}$	46. $\frac{3}{4}$, $\frac{3}{8}$	50. $3\frac{3}{8}$, $1\frac{3}{4}$

—1. Did you ever think of **the arithmetic in a glass of milk?** To supply the 125,000,000 people in this country, there are about 22,000,000 cows. To the nearest whole number, this is one cow to how many people?

— 2. About 50% of the cows in Ex. 1 are in the North Central states. About how many cows are there in these states?

— 3. The state having the largest number of cows is Wisconsin. In a year when the total number of cows in the country was 21,824,000, Wisconsin had 2,014,000 cows. To the nearest 0.1%, this was what per cent of the total?

—4. In a year when the whole United States produced about 350,000,000 lb. of cheese, the state of Wisconsin produced about 260,000,000 lb. To the nearest 1%, Wisconsin produced what per cent of all the cheese?

5. Milk and cream are usually graded according to the per cent of butter fat which they contain. When we speak of 3% milk, we mean milk in which 3% of the weight is butter fat. How much butter fat is there in 50 lb. of 3% milk?

6. The weight of 3% milk is 8.60 lb. to the gallon. How many pounds of butter fat are there in 25 gal. of 3% milk?

7. What was the per cent of butter fat in 140 lb. of milk from which 7.7 lb. of butter fat was obtained?

8. A Nebraska farmer hauled some milk to a creamery where it was tested and found to contain $4\frac{3}{4}$% butter fat. From this milk, 58.9 lb. of butter fat was obtained. How much milk was there in the lot?

9. Butter contains 82.4% butter fat, 13.9% water, 2.5% salt, and 1.2% curd. How many pounds of each are there in 500 lb. of butter?

10. A gallon of 28% cream at ordinary temperature weighs 8.37 lb. How much do 100 gal. of 28% cream weigh? How many pounds of butter fat are there in the 100 gal.?

11. Bessie, Mr. Hill's prize cow, gave 9800 lb. of 4.8% milk last year, and White Star gave 9400 lb. of 5% milk. Which cow produced more butter fat, and how much more?

12. In Ex. 11, Mr. Hill had two other cows, one of which gave 4200 lb. of 2.3% milk and the other 3300 lb. of 2.5% milk. How many pounds of butter fat did each cow produce? How do these cows compare with those in Ex. 11?

13. One year a farmer sold 38,500 lb. of milk which tested 4.6% butter fat. How much butter fat did the milk yield?

14. In Ex. 13, the farmer was paid at the rate of 50¢ a pound for the butter fat. How much did he receive?

Read and complete these statements:

1. 2% of \$30 means $\frac{2}{100}$ of \$——, which is \$——
2. 6% of \$200 means —— of \$——, which is \$——
3. 25% of \$80 equals $\frac{1}{4}$ of \$——, which is \$——
4. 50% of \$50 equals —— of \$——, which is \$——
5. 100% of \$5 means $1 \times$ \$——, or \$——
6. 125% of \$8 means $1\frac{1}{4} \times$ \$——, or \$——

Copy and complete these statements:

7. $4\% = \frac{}{100} = \frac{}{25}$
8. $5\% = \frac{}{100} = \frac{}{20}$
9. $50\% = \frac{}{100} = \frac{}{}$
10. $10\% = \frac{10}{} = \frac{}{10}$
11. $20\% = \frac{}{100} = \frac{1}{}$
12. $75\% = \frac{}{} = \frac{}{}$
13. $100\% = \frac{}{100} = 1$
14. $12\frac{1}{2}\% = \frac{}{100} = \frac{}{200} = \frac{}{8}$
15. $37\frac{1}{2}\% = \frac{}{100} = \frac{}{200} = \frac{}{8}$
16. $33\frac{1}{3}\% = \frac{}{100} = \frac{}{300} = \frac{}{}$

Find these per cents:

17. 6% of \$175
18. $5\frac{1}{2}\%$ of \$250
19. $3\frac{3}{4}\%$ of \$600
20. $7\frac{1}{2}\%$ of \$850
21. $33\frac{1}{3}\%$ of \$48.75
22. $16\frac{2}{3}\%$ of \$82.80
23. $37\frac{1}{2}\%$ of \$176.40
24. $66\frac{2}{3}\%$ of \$54.96

Find the number that is

25. 100% of 10
26. 10% of 100
27. 125% of 440
28. 5% more than \$25
29. 8% less than \$50
30. 100% less than \$1

1. Most of our meat comes from the great cattle ranches of the Central states. One year there were 39,494,000 head of cattle in these states. At an average of 950 lb. per head, how much did these cattle weigh?

2. People in this country eat an average of 58.4 lb. of beef each year. At this rate, how many tons (2000 lb.) are required per year for our population of 125,000,000 people?

As in Ex. 2, find how much of these meats are needed when the yearly averages per person are as follows:

3. Veal, 7.4 lb. 4. Lamb, 5.4 lb. 5. Pork, 67.5 lb.

6. If the average amount of meat eaten yearly per person in this country is 142.8 lb., how many tons of meat are used per year by our population of 125,000,000 people?

1. Cattle are sent from the ranches to the stockyards, where they are killed and dressed for market. The meat is then shipped from the stockyards in refrigerator freight cars, each of which holds about 30,000 lb. How many refrigerator cars are needed to carry 24,870,000 lb. of meat?

2. If the dressed meat averages 55% of the live weight, what will be the weight of the meat from 100 cattle averaging 925 lb. apiece, live weight?

3. A farmer shipped to the stockyards 20 head of cattle which averaged 965 lb. apiece. How much did the shipment weigh? At $6\frac{3}{4}$¢ a pound, how much did the farmer receive?

4. If $1280.64 is received for 60 hogs averaging 232 lb. each, what is the price per pound?

5. Prices are usually stated as so much per 100 lb. When beef brings $15.50 per 100 lb., what is the price per pound?

6. At \$16.75 per 100 lb., what is the value of a shipment of dressed beef that weighs 1240 lb.?

7. During the World War, a large meat packer shipped 400 carloads of meat abroad each week. At 30,000 lb. per car, how many tons were shipped per week?

8. In one year, 142,000 cattle were delivered at the stockyards in Cincinnati. At an average of 30 cattle per car, how many cars were used to carry this number?

9. In a recent year there were 1,317,000 cattle in Colorado and 3,720,000 in Iowa. How many more cattle did Iowa have? What per cent more did Iowa have?

10. A beef animal furnishes not only meat, but also hide, tallow, and more than 250 by-products of which soap is one. After the system of using the by-products was developed by the stockyards, the cattle raiser received \$10 more per animal. How much more per year does this mean to a stockman who ships 12,000 head of cattle each year to the stockyards?

Time : 8 min.

1. $4\frac{7}{8} + 3\frac{1}{2}$ **3.** $4\frac{7}{8} \times 3\frac{1}{2}$ **5.** $4\frac{7}{8} \div 4\frac{7}{8}$

2. $4\frac{7}{8} - 3\frac{1}{2}$ **4.** $4\frac{7}{8} \div 3\frac{1}{2}$ **6.** $0 \div 4\frac{7}{8}$

7. 225% is what decimal? what mixed number?

8. 5 is 5% of what number? $2\frac{1}{2}$% of what number?

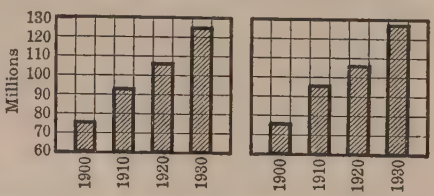
9. 9 in. is what per cent of 1 ft.? of 1 yd.? of 9 in.?

10. What per cent is $\frac{1}{100}$? $\frac{1}{1000}$? $\frac{1}{10}$? $\frac{75}{100}$? $\frac{3}{4}$?

GRAPHS are useful in presenting statistics because they help you **to compare facts at a glance** more easily than you can do with a list of numbers.

You already know how to read a graph, and on this page and the next you will have a chance to study some graphs of important statistics about our country.

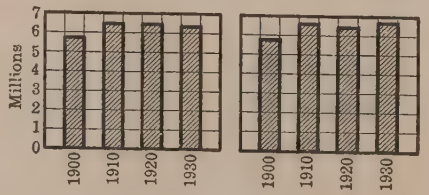
1. The approximate population of our country for the period from 1900 to 1930 is estimated, to the nearest million, by the Bureau of the Census as follows: 1900, 76; 1910, 92; 1920, 106; 1930, 125. These figures do not include Alaska, Hawaii, and the Philippines. One of these two graphs shows these statistics correctly. Find the one that is not correct and point out two mistakes in it.



In Ex. 1, find to the nearest 1% the increase from

2. 1900 to 1910 3. 1910 to 1920 4. 1920 to 1930

5. To the nearest million, the approximate number of farms in the United States for the same period of years as in Ex. 1 is estimated as follows: 1900, 5.7; 1910, 6.4; 1920, 6.4; 1930, 6.3. One of these two graphs showing these statistics is correct and the other is not. Which graph is not correct? Find two mistakes in it.



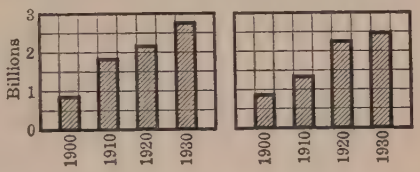
In Ex. 5, find to the nearest 1% the increase or decrease in the number of farms from

6. 1900 to 1910 7. 1910 to 1920 8. 1920 to 1930

9. In Exs. 1 and 5, compare the graphs of population and of the number of farms, and tell which is increasing more rapidly. Can you give any reason for this difference?

10. In the farms mentioned in Ex. 5, the total number of acres, to the nearest hundred million, is estimated as follows: 1900, 8.4; 1910, 8.8; 1920, 9.6; 1930, 9.1. Draw a graph like the correct one in Ex. 5 to show these statistics.

11. The approximate value of the corn raised in the United States, in billions of dollars, is estimated as follows for the years from 1900 to 1930: 1900, 0.9; 1910, 1.4; 1920, 2.2; 1930, 2.5. Which of these two graphs shows these facts incorrectly? Find two mistakes in it.



12. The approximate value, in billions, of the wheat raised in the same years as in Ex. 11 was as follows: 1900, 0.4; 1910, 0.6; 1920, 1.2; 1930, 1.0. Draw a graph to show these statistics and compare it with the correct graph in Ex. 11.

13. In 1920 there were approximately 229,000 tractors in use on farms, and there were 31,600,000 people living on farms. In 1925, there were 438,000 tractors and only 29,000,000 people living on farms. Draw a graph comparing the number of tractors for these two years, and another comparing the number of people. Can you see any reason why one graph shows a decrease while the other shows an increase?

Copy in column form and then add:

1. $\$2.15 + \$16.05 + \$9.10 + \$18.56 + \$15.00$
2. $\$1.05 + \$2.78 + \$0.89 + \$6.50 + \$8.00 + \$0.75$
3. $4.26 + 17.08 + 30.57 + 6.06 + 0.92 + 17.63$
4. $5.372 + 19.608 + 37.531 + 0.369$
5. $283.4 + 0.7 + 100.6 + 34.7 + 5.8 + 1.0 + 71.3$

Subtract, writing the answers on folded paper:

6.	7.	8.	9.	10.
\$12.56	\$9.05	8.75	65.08	6.700
2.87	.66	2.27	.75	2.855

Multiply, being careful about the decimal points:

11.	12.	13.	14.	15.
\$13.50	\$2.46	2.68	40.06	2.0060
4.7	9.5	1.2	20.3	0.9

16.	17.	18.	19.	20.
\$98.75	\$7.98	1.537	809.7	20,460
0.68	5.5	85	0.49	0.08

21. By dividing, show that $33{,}372 \div 309 = 108$.

From Ex. 21, write these quotients without dividing:

22. $30.9\overline{)33.372}$ 23. $3.09\overline{)333.72}$ 24. $0.309\overline{)0.033372}$

Divide, being careful about the decimal points:

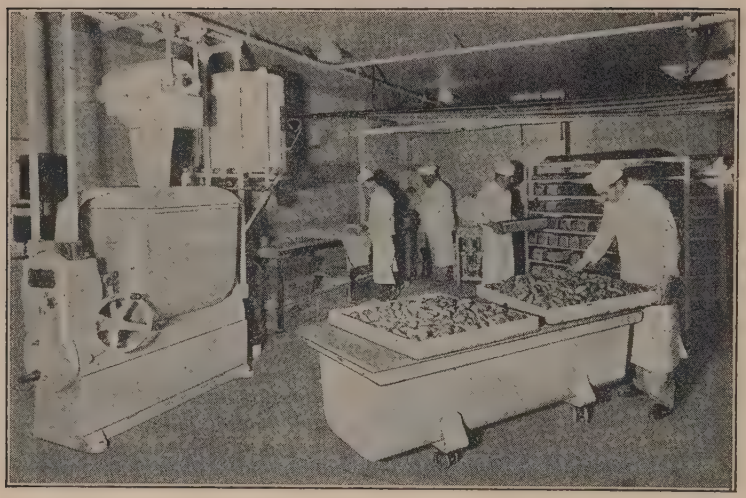
25. $36\overline{)\$972.00}$	28. $1.35\overline{)6.075}$	31. $144\overline{)3.888}$
26. $81\overline{)\$36.45}$	29. $16.2\overline{)7290}$	32. $162\overline{)437.4}$
27. $2.7\overline{)\$12.15}$	30. $0.72\overline{)1.944}$	33. $0.54\overline{)0.4374}$

1. Bread is made chiefly from wheat flour. Most of the wheat raised in this country is grown in the Central states. In a year when 903,865,000 bu. of wheat were grown, the highest price paid in Chicago was \$1.94 a bushel and the lowest price was \$1.30. How much would the wheat have brought if it had all been sold at the highest price? at the lowest price?

2. In Ex. 1, the average price received by the farmers was \$1.58. How much did a farmer receive for 2850 bu.?

3. A freight car 36 ft. long and 8 ft. 4 in. wide is filled with wheat to a depth of 4 ft. 9 in. At $1\frac{1}{4}$ cu. ft. to a bushel, how many bushels of wheat are there in the car?

4. When the wheat is ground into flour, it makes four grades as follows: bread flour, 70%; coarse flour, 1%; Red Dog flour, 2%; shorts or bran, 27%. How many pounds of each kind of flour can be produced from 30 T. of wheat?



1. In a recent year the bakeries in the United States produced bread and pastry valued at 1123 million dollars. What was the value of these products per person for our population of 125 million?

2. The value of the bread and pastry produced 2 yr. later than in Ex. 1 was 1268 million dollars. To the nearest 0.1%, what was the per cent of increase?

3. In making a large quantity of bread, a baker used the following materials: flour, 100 lb.; water, 60 lb.; yeast, 1 lb.; salt, $1\frac{1}{2}$ lb.; shortening, $1\frac{1}{2}$ lb.; sugar, 2 lb.; milk, 1 lb. How many pounds of material did he use?

In Ex. 3, find to the nearest 0.1% the per cent of the total weight represented by the

4. Flour. 5. Water. 6. Yeast. 7. Salt. 8. Sugar.

9. The Daylight Bakery uses a temperature of 425° for baking bread and 35% less than this for cookies. To the nearest 5°, what temperature is used for baking cookies?

10. In baking 10,000 pieces of pastry in a gas oven, a bakery used 2500 cu. ft. of gas. At $1.20 per 1000 cu. ft., how much did the gas cost? How much did it cost for each 100 pieces?

11. The Modern Bakery can bake 100,000 loaves of bread in 24 hr. What is the average number baked per hour?

12. At $4\frac{1}{4}$¢ per loaf, how much will a bakery receive in a day when 82,400 loaves of bread are sold?

13. The White Bakery has a machine which bakes 7000 ice-cream cones per hour. If this machine is operated 24 hr. a day, how many cones can it bake in $2\frac{1}{2}$ da.?

14. Bread is not always baked in loaves of the same size or weight. Find the weight of 60 loaves of rye bread which weigh 11 oz. each.

15. Find the weight of 35 loaves of graham bread which weigh 1 lb. 8 oz. each; of 20 loaves of whole-wheat bread which weigh 1 lb. 12 oz. each.

16. If 3 doz. rolls weigh 5 lb., how much will 120 doz. weigh? Since $120 = 3 \times 40$, what easy short cut can you use here?

17. If 4 doz. sugar buns weigh $4\frac{1}{2}$ lb., how much will 80 doz. of these buns weigh?

18. At one store they sell a loaf of white bread that weighs 1 lb. 4 oz. for 9¢, and at a second store they sell a loaf that weighs 1 lb. 8 oz. for 10¢. To the nearest 0.01¢, which costs the more per ounce, and how much more does it cost?

19. If a 2-pound sandwich loaf is sold at 12¢, how does the price per ounce compare with the prices in Ex. 18?

JUST as boys and girls must be fed in order to grow, so **plants must be fed with the proper kind of food to make them grow.** Plants take some food from the air through their leaves, but most of it comes from the soil, and is taken in through the roots.

If the soil does not contain enough food for the plants, they must be fed with fertilizer, of which there are many different kinds. **Selecting the proper kind of fertilizer is an important part of farming.**

1. A farmer spent \$4.86 per acre for fertilizer for his corn. It increased the yield 8.4 bu. per acre. If he received 75¢ a bushel for the corn, how much did he gain per acre?

2. A Kansas farmer harvested 24.5 bu. per acre from a wheat field which had not been fertilized and 34.3 bu. per acre from one on which he had put fertilizer. The fertilized field yielded what per cent more than the unfertilized field?

3. In Ex. 2, how many bushels of wheat did the farmer get from 60 A. of the unfertilized land?

4. If the wheat in Ex. 3 made 43 lb. of flour per bushel, how many $24\frac{1}{2}$-pound bags of flour did the 60 A. produce?

5. As in Exs. 3 and 4, find the number of bushels of wheat and the number of bags of flour that were produced by 60 A. of the fertilized land.

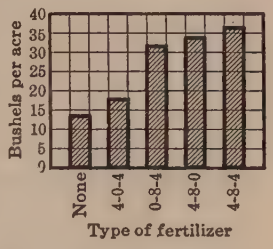
6. Plant food consists largely of **nitrogen, phosphoric acid,** and **potash.** A "2-8-2 fertilizer" is one that contains 2% nitrogen, 8% phosphoric acid, and 2% potash. The rest consists of other solids to give bulk. What per cent of this fertilizer is made up of the three plant foods?

7. In Ex. 6, what per cent of the fertilizer is made up of other solids?

8. From Ex. 7, find how many pounds of other solids there are in 75 lb. of a 2-8-2 fertilizer.

9. In 600 lb. of a 2-8-2 fertilizer (Ex. 6), how many pounds of nitrogen are there? how many pounds of phosphoric acid? how many pounds of potash?

10. While reading his farm paper, Mr. Brown found this graph showing the results of using different kinds of fertilizers on fields of wheat. From the graph, find the number of bushels per acre obtained by the use of the 4-8-4 fertilizer.



11. In Ex. 10, how much wheat would be obtained from 48 A.?

From the graph in Ex. 10, find the yield from 48 A. for the following kinds of fertilizer:

12. 4-0-4 **13.** 0-8-4 **14.** 4-8-0 **15.** None

16. How many pounds of each of the three plant foods are there in 1 T. of 4-8-4 fertilizer?

17. Mr. Brown buys 4-8-4 fertilizer in 100-pound bags at \$4.25 a bag. A bag is enough for $\frac{1}{4}$ A. How much will it cost him for enough fertilizer for 3 A.?

1. Fruit and vegetables are usually shipped by rail to the large cities from the states where they are grown. In a recent year there were 910,000 carloads of fruit and vegetables shipped to city markets. At an average of 15.4 T. per car, how many tons were shipped? How many pounds were shipped?

2. In a recent year, there were 4500 carloads of apples shipped to New York City from different parts of the state. At 15.4 T. per car, how many tons was this?

3. In the same year the state of Washington shipped $12\frac{1}{2}\%$ more than the 4500 carloads mentioned in Ex. 2. At 15.4 T. per car, how many tons of apples were shipped from Washington?

4. In a recent year 529 carloads of cabbages were shipped to Chicago from Texas, while from Wisconsin, which is much nearer, only 65.6% as many were shipped. How many carloads were shipped from Wisconsin?

5. In Ex. 4, how many carloads were shipped to Chicago from both states? If the carloads averaged 12.4 T. each, how many tons were shipped?

6. The fruit and vegetables used by Cleveland in a recent year came from 45 different states, while those used by New York City came from only 40 different states. The number of states supplying New York City was what per cent less than the number supplying Cleveland?

7. In a shipment of 3 carloads of fruit, averaging 14.5 T. to a car, it was found that 500 lb. of fruit had spoiled because of poor packing. What per cent of the fruit was spoiled?

8. It is estimated that in a recent year North Carolina raised 14.8% of the strawberries grown in this country, while Tennessee raised 12.9%. North Carolina raised what per cent more than Tennessee?

THERE are many different kinds of puzzles that you can make with numbers. If there is time, here are some "missing-number" puzzles that you will like to do "just for fun." They make a good guessing game.

In these additions, find the figures that belong where the stars are, and tell how you found them:

1.	2.	3.	4.	5.
247	709	84	90*	***
36*	*9*	79*	5*8	75
1*5	790	*8	810	807
*91	*0	*79	68	457
1623	2504	1650	**55	2013

Find the missing figures in these subtractions:

6.	7.	8.	9.
534*	***7	684**	$932.**
*1*6	310*	58*60	**.98
3*40	4332	*846	$885.02

Find the missing figures in these multiplications:

10.	11.	12.	13.
123	***	**6	8**
**	42	*7	*7
615	418	95*	**63
***	***	*44	**6*
553*	****	****	*2*9*

Find the missing figures in these divisions:

14.	15.	16.
12	23	40
144)17*8	203)****	***)12000
***	***	****
28*	***	***
***	***	***

Problem Solving

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. Tom has a set of 30 books, each $1\frac{1}{2}$ in. thick. If he wishes to put them all on one shelf, how long a shelf will he need?

2. How many square yards of concrete will it take for the floor of a garage 24 ft. long and 18 ft. wide?

3. The difference in length between shoe sizes is $\frac{1}{3}$ in. A Number 5 shoe is how much shorter than a Number $6\frac{1}{2}$ shoe?

4. A school football team won 7 out of 12 games played one year. What per cent of the games did they win?

5. The average life of the swan, which is 100 yr., is what per cent longer than that of the heron, which is 60 yr.?

6. How many bottles will be needed for 21 qt. of sirup that is to be put into $1\frac{3}{4}$-pint bottles?

7. An acre of land contains 43,560 sq. ft. During a rainfall of 1 in., how many cubic feet of water fall on 1 A.?

8. A market gardener paid $14.50 per hundred for burlap bags. How much did it cost him for 1250 bags?

9. At an average of $1\frac{1}{4}$ lb. apiece, what will be the total weight of a shipment of 250 schoolbooks?

10. While the pedal of Jack's bicycle makes one revolution, the rear wheel makes $3\frac{1}{2}$. How many revolutions must the pedal make for 1400 revolutions of the rear wheel?

Problems about Coal

OUR life today is made easier by the use of machines. The power that runs these machines comes from three primary sources, — coal, water, and oil. There is, of course, a great deal of work necessary in changing these products into the forms in which they are finally used as power.

1. The coal supply of the world is estimated at more than 7,685,000 million metric tons. The metric ton is equivalent to 2205 lb., approximately. How many billion pounds of coal are there in the world?

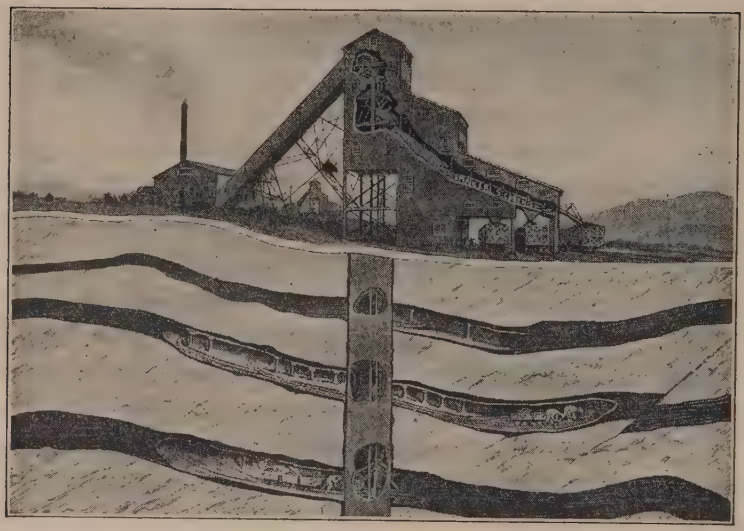
2. In a recent year, the world produced 1475 million metric tons of coal. This was what per cent of the world's supply, as given in Ex. 1?

3. In the same year as in Ex. 2, the United States produced 545,000,000 metric tons of coal. This was what per cent of the world's production (Ex. 2)?

4. In Ex. 3, how many pounds of coal did we produce that year? Taking our population that year as 120 million, how many pounds per person were produced?

5. For every 500 T. of coal used in the United States it is estimated that the amounts used for different purposes are as follows: industries. 175 T.; railroads, 125 T.; heating and cooking in homes, 82.5 T.; made into coke, 65 T.; exported, 30 T.; coal-mine fuel, 17.5 T.; gas works, 5 T. Find what per cent is used for each purpose.

6. One year we produced approximately 83,900,000 T. of anthracite (hard coal), and the next year 79,400,000 T. Find, to the nearest 0.1%, the per cent of decrease.



1. In the usual type of coal mining, a vertical shaft is sunk in the ground, and then horizontal galleries are dug from this at different depths. In a western mine, the vertical shaft is 600 ft. deep. If the average depth of mine shafts is 350 ft., this shaft is what per cent deeper than the average?

2. Gangways in a mine are usually built with a slight grade, a grade of 1% meaning a rise of 1 ft. in 100 ft. What is the per cent of grade for a rise of 1 ft. 6 in. in 200 ft.?

3. One day a miner dug enough coal to fill 3 cars. At an average of $2\frac{1}{2}$ T. per car, how much coal did he dig?

4. A mine laborer loaded 6 T. of coal one day into the cars. At $1.25 per ton, how much did he earn that day?

5. In one mine the miners worked only 120 da. last year. This is what per cent of a year of 300 working days?

6. How many cubic feet are removed in digging a chamber 24 ft. wide and 6 ft. high a distance of 25 ft.?

7. **At the mines, coal is measured by the long ton of 2240 lb.** At 50 lb. to the cubic foot, how many long tons are there in a mine car 10 ft. by 5 ft., filled to a depth of $2\frac{1}{4}$ ft.?

8. In one mine the track used for the cars is 3 ft. 6 in. wide. This is what per cent narrower than the standard width of 4 ft. $8\frac{1}{2}$ in. used by our railroads?

9. In ventilating mines, the minimum allowance of fresh air per miner is 100 cu. ft. per minute. How much fresh air is required per hour in a mine in which 350 men are working?

10. When water collects in a mine it must be removed by powerful pumps. How much water can be removed in 4 hr. by a pump with a capacity of 1200 gal. per minute?

1. The old-type wooden coal car could carry 80,000 lb., and the modern steel car can carry 140,000 lb. What, to the nearest ton, is the capacity in long tons (2240 lb.) of each type of car? What per cent more can the steel car carry?

2. A coal-carrying steamer was loaded with 6000 long tons of coal. How many coal cars, each carrying 140,000 lb., would be needed to carry this cargo by rail?

3. Before selling it, a retail coal dealer "screened" the cargo in Ex. 2 in order to remove slate and other foreign matter. The screenings amounted to 15%, by weight, of the coal. How many short tons (2000 lb.) did the dealer have left to sell?

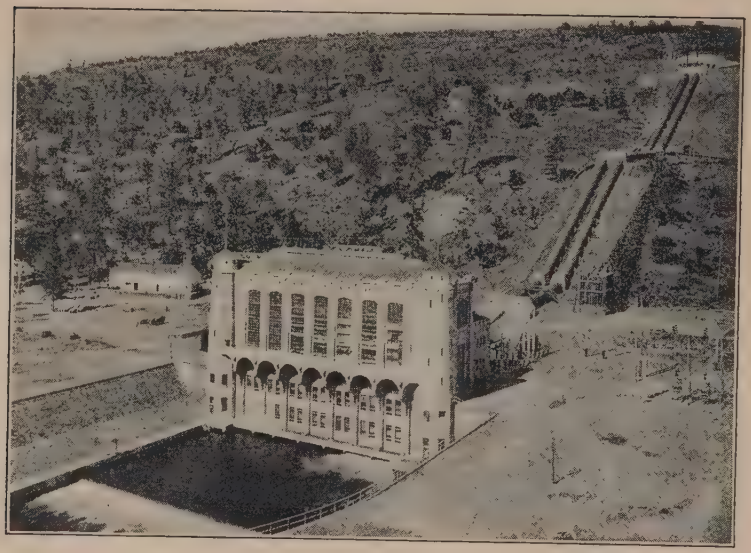
4. It is estimated that furnace coal occupies approximately 35.45 cu. ft. per ton and stove coal 34.35 cu. ft. per ton. How many more cubic feet will be occupied by 500 T. of furnace coal than by 500 T. of stove coal?

In Exs. 1 to 20, the second column (a to t) gives in a random order the answers to the examples in the first. Write the numbers 1 to 20 on your paper, and after each number write the letter that corresponds to the correct area:

Size of Rectangle	Area of Rectangle	Size of Rectangle	Area of Rectangle
1. $4' \times 7'$	*a* 28 sq. in.	11. $1' \times 1'$	*k*. 4 sq. in.
2. $2\frac{1}{2}'' \times 16''$	*b*. 40 sq. ft.	12. $2' \times 2'$	*l*. 1 sq. in.
3. $2'' \times 14''$	*c*. 1200 sq. ft.	13. $4'' \times 1''$	*m*. $1\frac{1}{8}$ sq. in.
4. $7\frac{1}{2}' \times 5\frac{1}{3}'$	*d*. $29\frac{1}{4}$ sq. in.	14. $\frac{1}{2}'' \times 2''$	*n*. $6\frac{1}{4}$ sq. in.
5. $30' \times 40'$	*e*. 28 sq. ft.	15. $7' \times \frac{1}{2}'$	*o*. 1 sq. ft.
6. $2.1'' \times 4''$	*f*. $29\frac{1}{4}$ sq. ft.	16. $\frac{1}{8}'' \times 9''$	*p*. 360 sq. in.
7. $3\frac{1}{4}'' \times 9''$	*g*. 6 sq. in.	17. $2\frac{1}{2}'' \times 2\frac{1}{2}''$	*q*. 360 sq. ft.
8. $6\frac{1}{2}' \times 4\frac{1}{2}'$	*h*. 6 sq. ft.	18. $1\frac{7}{8}'' \times 6\frac{3}{4}''$	*r*. $3\frac{1}{2}$ sq. ft.
9. $4'' \times 1.5''$	*i*. 8.4 sq. in.	19. $5' \times 6''$	*s*. 4 sq. ft.
10. $8' \times \frac{3}{4}'$	*j*. 40 sq. in.	20. $3' \times 120'$	*t*. $12\frac{2}{3}\frac{1}{2}$ sq. in.

As in Exs. 1–20, above, match the columns by writing opposite each example number the letter that corresponds to the correct volume:

Size of Rectangular Solid	Volume of Solid
21. 2 ft. $\times$ 7 ft. $\times$ $3\frac{1}{2}$ ft.	*a*. 264 cu. in.
22. $16\frac{1}{2}$ ft. $\times$ $8\frac{1}{4}$ ft. $\times$ 16 ft.	*b*. 2178 cu. in.
23. 2.5 in. $\times$ 3.2 in. $\times$ 4.5 in.	*c*. 36 cu. in.
24. 8 in. $\times$ $16\frac{1}{2}$ in. $\times$ 2 in.	*d*. 49 cu. ft.
25. 33 in. $\times$ $16\frac{1}{2}$ in. $\times$ 4 in.	*e*. 2178 cu. ft.



1. Our waterfalls and swift rivers are another source of power. Power is usually measured by the **horse power (H. P.)**, which is the amount required to raise 33,000 lb. a distance of 1 ft. in 1 min. How much power is needed to raise 33 T. a distance of 2 ft. per minute?

2. In a recent year the United States used approximately 435,000,000 H. P., of which 12,000,000 H. P. came from water. The water power was what per cent of the total?

3. California uses about 16.5% of the water power in our country. From Ex. 2, find how much California uses.

4. It is estimated that if we used all the water power of our rivers and waterfalls, there would be 38,110,000 H. P. available. The amount of water power used each year (Ex. 2) is what per cent of the available supply?

IN PROBLEMS about per cents there are usually three numbers involved. To take a simple case, suppose that you have a problem in which you find that **6% of 400 is 24.**

The **6%** in this case is often called the **rate per cent** (or simply the **rate**), the **400** is called the **base**, and the **24** is called the **percentage.** The rule for finding a per cent of a number may therefore be expressed as

Rate × base = percentage,

or, by using only the initial letters, as

$$r \times b = p.$$

$0.06 \times 400 = 24$
$r \times b = p$

When numbers represented by letters are to be multiplied, the sign × is usually omitted, and so the rule becomes

$$rb = p.$$

The statement $rb = p$ is called a **formula.** As you have seen, it means "Rate times base equals percentage."

A formula is a kind of shorthand for writing rules.

---

1. If $r = 5\%$ and $b = \$125$, $p = rb = 0.05 \times \$125 = \$6.25$. What is the value of p when $r = 4\%$ and $b = \$200$?

Find the values of p that belong in the blank columns:

	r	b	p
2.	4 %	\$700	
3.	$3\frac{1}{2}$ %	\$500	
4.	$16\frac{2}{3}$ %	\$300	
5.	25 %	\$960	

	r	b	p
6.	8 %	40 mi.	
7.	9 %	30 ft.	
8.	12 %	60 yd.	
9.	80 %	900 H.P.	

THE world's use of water power is estimated at 34 million horse power, of which 18 million is used by North America. As you already know, to find the per cent used by North America, divide 18 by 34; that is,

$$\text{Per cent} = 18 \div 34$$

Since 18 is the **percentage** and 34 is the **base**, the rule for finding what per cent (**rate**) one number is of another is

$$\text{Rate} = \text{percentage} \div \text{base},$$

or $$r = p \div b,$$

which is usually written in the form

$$r = \frac{p}{b}.$$

$$\begin{array}{r} 0.5294 \\ 34\overline{)18.0000} \\ 17\,0 \\ \hline 1\,00 \\ 68 \\ \hline 320 \\ 306 \\ \hline 140 \\ 136 \\ \hline 4 \end{array}$$

In the case given above, $p = 18$ and $b = 34$. Dividing as shown, the value of r to the nearest 0.1 % is 52.9 %.

---

1. Complete this statement: The formula $r = \frac{p}{b}$ shows that to find the rate (per cent), I divide the ——.

2. In Ex. 1, find the value of r when $p = 15$ and $b = 60$.

Using the formula of Ex. 1, find in each of these cases the per cent that the first number is of the second:

3. 45, 90
4. 90, 45
5. 45, 45
6. 90, 90
7. 17 ft., 85 ft.
8. 37 yd., 148 yd.
9. 144°, 360°.
10. 148 mi., 37 mi.
11. 19 H. P., 114 H. P.
12. 114 H. P., 19 H. P.
13. 114 H. P., 190 H. P.
14. $37\frac{1}{2}$ H. P., $87\frac{1}{2}$ H. P.

THE third problem relating to per cents is that of finding the number of which a given number is a given per cent. For example, to find the number (the **base**) of which 15 is 3 %, you divide 15 by 0.03; that is, in this case

$$\text{Base} = 15 \div 0.03$$

$$0.03\overline{)15.00}$$
$$5\ 00.$$

Here 15 is the **percentage** and 0.03, or 3 %, is the **rate** (per cent).

Briefly expressed, the rule for solving this case is therefore

$$\text{Base} = \text{percentage} \div \text{rate},$$

or
$$b = \frac{p}{r}.$$

You do not need to learn long rules if you learn the formula which states the rule in a much easier way.

---

1. The water power used by Illinois is about 95,000 H.P., which is $47\frac{1}{2}$ % of what Vermont uses. How much water power does Vermont use? See if you can find in your geography the reason why Vermont uses more than Illinois.

Using the formula given at the top of the page, find the values of b that belong in the blank columns:

	p	r	b
2.	\$20	4 %	
3.	\$15	$7\frac{1}{2}$ %	
4.	\$250	$6\frac{1}{4}$ %	
5.	\$500	$2\frac{1}{2}$ %	
6.	\$2200	$5\frac{1}{2}$ %	

	p	r	b
7.	4 mi.	5 %	
8.	7 ft.	50 %	
9.	148 H.P.	25 %	
10.	300 H.P.	$16\frac{2}{3}$ %	
11.	80 H.P.	$12\frac{1}{2}$ %	

Meaning of Ratio

IN STUDYING about our great industries, you have seen how often it is necessary to compare the sizes of numbers. For example, in comparing the amount of water power used by Arkansas, which is 15,000 H.P., with that used by Ohio, which is 30,000 H.P., you can say that Arkansas uses 50%, or $\frac{1}{2}$, as much as Ohio.

Another way to compare these numbers is to say that the ratio of the power used by Arkansas to that used by Ohio is $\frac{15000}{30000}$, which is usually read "15,000 to 30,000." Since in its simplest form the fraction $\frac{15000}{30000}$ is equal to $\frac{1}{2}$, it is better to say that the ratio is 1 to 2; that is,

$$\frac{\text{Power used by Arkansas}}{\text{Power used by Ohio}} = \frac{15000}{30000} = \frac{1}{2}.$$

To find the ratio of one number to another, divide the first by the second and give the quotient in its simplest form.

State in the simplest way the ratio of

1. 3 to 6
2. 18 to 36
3. 3 in. to 12 in.
4. 3 in. to 1 ft.
5. 1 ft. to 1 yd.
6. 1 in. to 1 ft.

7. In the United States as a whole, for every 100 women there are 104 men. What is the ratio of women to men? of men to women?

8. In a house plan which is drawn to the scale of 1 in. to 10 ft., what is the ratio of the length of the house in the plan to the real length of the house?

9. Jim is 12 yr. old and his father is 48 yr. old. What is the ratio of Jim's age to his father's? Jim's age is what per cent of his father's age?

10. What is the ratio of a common ton (2000 lb.) to a long ton (2240 lb.)? of a long ton to a common ton?

11. In 2-8-2 fertilizer, there is 2% nitrogen, 8% phosphoric acid, and 2% potash. What is the ratio of nitrogen to phosphoric acid? of phosphoric acid to potash?

12. In making a large quantity of bread, a baker used 100 lb. of flour and 60 lb. of milk and water. What was the ratio of the amount of liquid to the amount of flour?

13. In screening a shipment of 150 T. of coal, 15 T. of dirt and other foreign substances were removed. What was the ratio of the material removed to the original amount of coal?

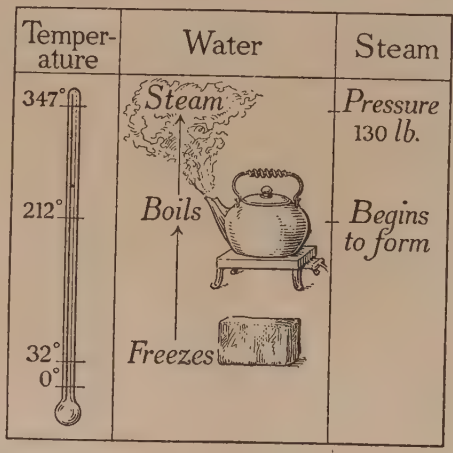
14. It is estimated that if all the water power of the world were developed, there would be 459 million horse power. Of this only 34 million horse power is being used today. What is the ratio of the power used today to the total supply?

15. One family's budget is planned as follows: house, 25%; food, 30%; clothing, 12%; advancement, 10%; savings, 10%; health, 5%; miscellaneous, 8%. Find the ratio between the amounts allowed for health and for savings; for house and for food; for savings and for advancement; for health and for clothing; for food and for clothing.

16. In using letters to represent numbers, the ratio of a to b is expressed as $\frac{a}{b}$. Find the value of this ratio when $a = 12$ and $b = 8$; when $a = 15$ and $b = 5$; when $a = 4.2$ and $b = 8.4$.

17. The ratio of the sum of two numbers to their difference is expressed as $\frac{a+b}{a-b}$. Find the value of this ratio when $a = 4$ and $b = 2$; when $a = 16$ and $b = 8$; when $a = 0.64$ and $b = 0.32$; when $a = 2\frac{1}{2}$ and $b = 1\frac{3}{4}$.

IN OUR great industries, **a large part of the power comes from steam.** When water is heated until it reaches a temperature of about 212°, the water begins to boil and steam starts to form. When the steam is confined, as in an engine boiler, and reaches a temperature of about 347°, it presses against the inside of the boiler with a force of 130 lb. on each square inch of surface.



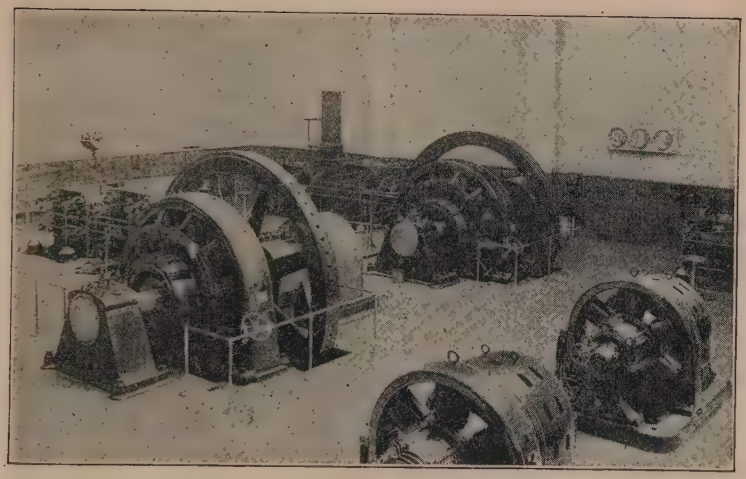
It is steam pressure that makes a steam engine go.

1. How many degrees are there between the freezing point of water (32°) and the boiling point (212°)?

2. The space occupied by 1 lb. of water is 0.016 cu. ft., and the total amount of steam generated by the water when heated to 212° occupies 26.56 cu. ft. Steam occupies how many times as much space as the water from which it is made?

3. At sea level, water boils at 212°. There is a drop in the boiling point of about 1.8° for each 960 ft. that you rise above sea level. Find, to the nearest 1°, the boiling point of water at Denver, which is 5000 ft. above sea level.

4. To turn 1 lb. of water into steam, it takes an average of 1.6 oz. of coal. How many pounds of water can be turned into steam by 1 T. (2000 lb.) of coal?

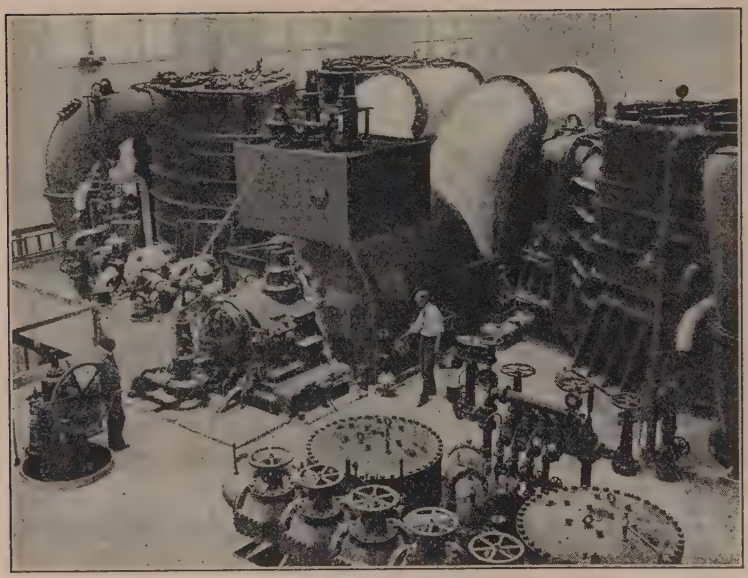


1. James Watt, a Scotchman, perfected the first workable steam engine in 1782. How many years ago was this?

2. The efficiency of a steam engine and boiler is sometimes stated as the number of pounds of coal required to produce 1 H. P. per hour. How much coal is needed per hour to produce 250 H. P. in an engine which requires 1.2 lb. of coal per horse power per hour?

3. For each horse power delivered per hour in one type of engine, it requires 40 lb. of steam. If 1 lb. of coal will produce 10 lb. of steam, how much coal will be needed per hour when the engine is producing 110 H. P.? when the engine is producing 175 H. P.?

4. In one form of steam engine, called a **turbine**, steam issues from nozzles at an average rate of 2500 ft. per second. This is what per cent faster than the speed of sound, which is approximately 1090 ft. per second?



1. This is an age of electricity. Electric power is measured by the **kilowatt (kw.)**, which is equivalent to 1.34 H. P. How many kilowatts does it take to equal 200 H. P.?

2. Electric power comes from generators driven either by steam or water power. One year $34\frac{1}{2}\%$ of the 75,000,000 kw. produced was generated by water power and the rest by steam. How many kilowatts were generated by each means?

3. In a recent year the capacity of the plants generating electricity for public use in this country was 39,000,000 H. P. This is equivalent to how many kilowatts?

4. A generator attached to a 150-horse-power steam engine is delivering 110.78 kw. How many horse power less are being delivered by the generator than by the engine?

IN THE home, electricity is usually measured by the **kilowatt hour (kw. h.)**, which means that power is being used **at the rate of 1000 watts per hour.** For example, a 600-watt electric flatiron uses 0.600 kw. for each hour it is operated.

1. Mrs. Modern's electric flatiron costs her 4.8¢ an hour for electricity. If she uses the iron $4\frac{1}{2}$ hr. a week, how much, to the nearest cent, does the electricity cost per week?

2. It costs Mrs. Modern 1.8¢ per hour for the electricity to run her vacuum cleaner. If she runs it 20 min. a day for 6 da. each week, how much will it cost for the 42 wk. that she uses it during the year?

3. One week in July Mrs. Modern used $4\frac{1}{2}$ kw. h. of electricity in running the ventilating fan in the kitchen. At 10¢ per kw. h., how much did it cost her for the electricity?

4. Mrs. Modern has a 400-watt electric coffee percolator. If she uses it an average of $8\frac{1}{2}$ hr. per month, how much per month does the electricity cost at 10¢ per kw. h.?

5. The heating element in the oven of her electric stove is a 2000-watt unit. At 4¢ per kw. h., how much will the electricity cost for a roast that requires $2\frac{1}{2}$ hr. to cook?

6. A common size of electric lamp is a 50-watt bulb. How many kilowatt hours will 14 such lamps use if they are burned an average of $4\frac{1}{2}$ hr. per day for 30 da.? At 10¢ per kw. h., how much will the electricity cost?

7. The electric motor on Mrs. Modern's sewing machine is marked $\frac{1}{30}$ H. P. To how many watts (1 H. P. = 746 watts) is this equivalent? At $8\frac{1}{2}$¢ per kw. h., how much, to the nearest 0.1¢, does it cost per hour to use the machine?

THE power that runs our automobiles comes chiefly from gasoline, which, in turn, comes from petroleum (oil). **Oil has become an important source of power.**

The largest oil fields in this country are located in California, Oklahoma, and Texas.

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1. In a recent year there were 800,000,000 bbl. of crude oil produced in the United States. At 42 gal. to the barrel, how many gallons was this?

2. It is estimated that in all the oil fields of our country there are about 9000 million barrels of oil. The amount given in Ex. 1 is what per cent of the total available supply?

3. Modern science has discovered more than 200 uses for petroleum products. Out of every barrel (42 gal.) of crude oil, the amounts used for the most important purposes are estimated as follows: fuel oil, 20.1 gal.; gasoline, 10.8 gal.; kerosene, 4.1 gal.; paraffin and mineral oil, 2.5 gal.; wax, coke, and asphalt, 1.0 gal.; lubricating oil, 1.8 gal. Find what per cent of the crude oil is used for each purpose.

4. A sign at a filling station gives the price of gasoline as 21¢ per gallon. In a recent year we used 10 billion gallons of gasoline. At the filling-station price, what would have been the value of all this gasoline?

5. By keeping a record of the gasoline used, Mr. Howe finds that his car averages 18 mi. to the gallon. How much gasoline will he use in a trip of 250 mi.?

6. An ocean liner with oil-burning engines used 105 T. of fuel oil per day on a recent trip. At $7\frac{1}{2}$ lb. to the gallon, what was the number of gallons of oil used per day?

Problems about Cotton

1. Clothes are made chiefly from cotton, wool, and silk. In a recent year the United States produced 14,000,000 bales of cotton. At 500 lb. to a bale, how many pounds was this? At an average of 10¢ a pound, what was the value of the crop?

2. In Ex. 1, there were 42,000,000 A. of land devoted to raising cotton. What was the average yield in pounds per acre?

3. A crop of cotton usually yields 1 part lint (from which thread is made) to 2 parts seed (from which cottonseed oil and other products are made). How many pounds of lint will there be in 1500 lb. of raw cotton?

4. The United States produces about $\frac{3}{5}$ of all the cotton grown in the world. In a year when the total cotton crop of the world was 21,000,000 bales, how much did we produce?

1. Australia, the great wool-producing country of the world, produces about 750,000,000 lb. a year, and the United States produces about 300,000,000 lb. a year. What fraction of the world's yearly production of 3,000,000,000 lb. is produced by each of these countries? The United States produces what per cent as much as Australia?

2. The average weight of wool from a sheep is 7.7 lb. How many sheep does it take to produce 300,000,000 lb. of wool?

3. After the wool is cleaned and combed, a fleece originally weighing 7.7 lb. will yield about 3.3 lb. of wool. The cleaned wool is what per cent of the weight of the original fleece?

4. Wool is also obtained from goats as well as sheep. The average weight of the fleece of an Angora goat is $4\frac{1}{2}$ lb., but a prize animal recently produced a fleece weighing $21\frac{1}{4}$ lb. This was how many times as heavy as the average?

5. Silk is obtained from the cocoons of silkworms, each of which spins about 400 yd. of silk fiber. How many miles of fiber will be produced by 5000 silkworms?

6. It is estimated that 2000 silkworms require 125 lb. of mulberry leaves for food during their growth. For how many silkworms would 10 T. of mulberry leaves be sufficient food?

7. Japan, China, Italy, and France are the world's largest producers of silk. We import about 83 million pounds of silk each year, valued at 387 million dollars. What is the average value per pound?

8. An artificial silk called **rayon** is made chiefly from wood pulp. In a recent year we made 80,000,000 lb. of rayon, which was $4\frac{1}{2}$ times the amount that we imported. How much rayon did we import that year?

1. The manufacture of clothing is the fourth largest industry in the United States. In a recent year the value of manufactured clothing was $2,381,000,000, and the value of the total manufactured products of all industries was $64,714,000,000. The value of the clothing was what per cent of the total?

2. In the same year as in Ex. 1, it took 3,990,000 H.P. to drive the machines used in manufacturing the clothing. How many dollars of value did each horse power produce?

3. The yearly manufacture of men's clothing in this country is valued at 1100 million dollars, and that of women's clothing at 1300 million. The value of the women's clothing is what per cent greater than that of the men's?

4. In Ex. 3, the value of the men's clothing is what per cent less than that of the women's?

5. In Ex. 3, what per cent of the total value of manufactured clothing does the women's clothing represent?

6. There are 3.7% fewer women than men (over 21 yr. of age) in the United States. In a recent year there were about 54,000,000 men in our country. How many women were there?

7. From Exs. 3 and 6, find how many dollars' worth of clothing were produced for each woman.

8. As in Ex. 7, find how many dollars' worth of clothing were produced for each man.

9. The textile industry (which means the manufacture of cloth for all purposes, including clothing) is the second largest in the United States. In the year mentioned in Ex. 1, the value of the manufactured products of the textile industry was $9,123,000,000. The value of the manufactured clothing was what per cent of that of the whole textile industry?

MRS. NYE made the following list of clothes that Myra needed for winter. She also put down the prices she expected to pay so as to see how much money was needed.

School dress	$15.00	Gloves, woolen	$1.25
Winter coat	25.00	kid	2.25
Winter hat	5.00	Underwear	10.00
School shoes	6.50	4 pr. stockings, each	.75

1. What is the total of all the items in the list?

2. Mrs. Nye's budget for the year allows $450 for clothes, of which Myra's share is $100. Myra's share is what per cent of the total? Myra's share is how much more than is allowed for all the items in the list?

3. By buying it at a sale, Mrs. Nye got a winter coat, originally marked $25, at 10% off. How much did she save?

4. Mrs. Nye paid $6.50 for material for Myra's school dress and $4 to a seamstress for making it up. How much less than the amount given in the list did the dress cost?

5. Myra had her last year's hat cleaned and reblocked for $1.25. This saved how much on what a new hat would cost?

6. Myra thought that she could make most of her underwear, and so they bought a piece of nainsook for $3.50 and 5 yd. of trimming at 15¢ a yard. They spent $3.50 for the rest of the underwear. How much did they save on this item?

7. For shoes, stockings, and gloves, Mrs. Nye paid just what she had planned. How much did these items cost in all?

8. From Exs. 3 to 7, find the total amount that was saved.

HERE is the list that Mrs. Nye made out before she went shopping to buy the clothes that Myra's brother Harry needed. The list also shows the prices that she expected to pay.

Overcoat	$20.00	6 shirts, each	$1.25
School suit	15.00	3 neckties, each	.50
Sweater	3.50	2 pr. knickers, each	3.00
Cap	1.00	6 pr. stockings, each	.50
Shoes	5.50	2 pr. gloves, each	.75
Underwear	5.50	1 doz. handkerchiefs	2.00

1. What is the total of all the items in the list?

2. Harry's share of the family clothing allowance is $100. It is how much more or less than the total in Ex. 1?

3. The sweater, cap, gloves, and underwear cost just what Mrs. Nye had planned. How much did they cost in all?

4. Mrs. Nye found some handkerchiefs for $1.50 a dozen, and she bought the neckties at 3 for $1.25. How much did she save on these items?

5. She could not find an overcoat for $20. The one that she wanted had been originally marked $27, but she could buy it now at a discount of $16\frac{2}{3}\%$. How much more or less than $20 would she have to pay for this coat?

6. She paid $15 for a suit that had been marked down 25%. At what price was the suit originally marked?

7. On the shoes, shirts, knickers, and stockings she was able to save 20%. How much did she save on these items?

8. From Exs. 3 to 7, find how much more or less Mrs. Nye paid for Harry's clothes than she had planned.

See how quickly you can do these additions:

1.	2.	3.	4.	5.
748	128.5	4375 mi.	$42\frac{1}{3}$	$74\frac{5}{8}$
329	593.2	6182 mi.	$89\frac{5}{6}$	$58\frac{1}{2}$

See how quickly you can do these subtractions:

6.	7.	8.	9.	10.
653	\$74.55	9182 ft.	$57\frac{3}{4}$	$67\frac{1}{2}$
249	59.39	5938 ft.	$29\frac{5}{8}$	$18\frac{15}{16}$

See how quickly you can find the products:

11. 27×592
12. $12\frac{1}{2} \times 68$
13. $74 \times 256\frac{1}{2}$
14. 35×160 ft.
15. $25 \times \$175.50$
16. $3\frac{1}{7} \times 28$ sq. in.

See how quickly you can find the quotients:

17. $25\overline{)\$37.50}$
18. $12\overline{)\$18.72}$
19. $7.32\overline{)475.8}$
20. $0.25\overline{)\$29.80}$
21. $3.14\overline{)847.8}$
22. $25.5\overline{)497.25}$

Tell how you check your work in

23. Addition.
24. Subtraction.
25. Multiplication.
26. Division.

Find the missing numbers:

27. $\frac{1}{4}$ of 724 is ——
28. 72 is —— of 144
29. ——% of 40 is 8
30. 17 is ——% of 68
31. $16\frac{2}{3}$ is —% of $33\frac{1}{3}$
32. 25% of \$420 is \$—
33. ——% of \$144 is \$96
34. $1\frac{1}{3}$ is ——% of 1
35. $37\frac{1}{2}$% is —% of 75%
36. —% of \$150 is \$37.50

Ancient and Modern Methods

THIS page illustrates eight stages of the world's methods of transporting goods. Much of the world's history is here, for without means of transportation the world would have remained in a savage state.

In each of the following cases, find how long it takes to carry a burden 10 mi. at the given rates per hour:

1. Savage, 2 mi.
2. Donkey, $2\frac{1}{4}$ mi.
3. Oxen drawing a primitive cart, $2\frac{1}{8}$ mi.
4. Primitive man with his wheelbarrow, $2\frac{3}{4}$ mi.
5. Early sailing boat, $3\frac{1}{4}$ mi.
6. Modern steamer, 25 mi.
7. Horse and wagon, 6 mi.
8. Railroad train drawn by an electric engine, 40 mi.
9. Motor truck, $22\frac{1}{2}$ mi.
10. Dirigible airship, 68 mi.
11. Airplane, 123 mi.

1. An ancient stone church was built $5\frac{1}{4}$ mi. from the quarry. If a workman with a wheelbarrow could make 2 round trips per day to the quarry, carrying 100 lb. on each return trip, how many days would it take him to move 1 T. of stone?

2. How long would it take a loaded donkey, traveling $2\frac{1}{4}$ mi. per hour, to go $5\frac{1}{4}$ mi.? Counting the same time each way, how long would it take a donkey to make 2 round trips?

3. In Ex. 2, if the donkey carried 200 lb. on each trip from the quarry, how many hours would it take him to move 1 T.?

4. A modern freight car can carry 140,000 lb. How many donkeys, each carrying 200 lb., would it take for this load?

5. At 36.75 mi. per hour, in how many minutes can a freight train travel $5\frac{1}{4}$ mi.?

6. From Exs. 1 and 4, find how long it would have taken one man to move the amount of stone that can be carried in the modern freight car.

7. If the architect who planned the church in Ex. 1 lived 250 mi. away, how long would it have taken him to reach the church on horseback, riding $12\frac{1}{2}$ mi. a day over rocky paths? How long would it take him today in an express train traveling at 60 mi. per hour? in an airplane at 125 mi. per hour?

8. A recent record of 713 nautical miles for one day's run was made by a large ocean liner. A nautical mile is equivalent to about 1.15 land miles. How many land miles was this?

9. In 1929 a fast ocean liner made the trip across the Atlantic in $4\frac{3}{4}$ da. It is estimated that if Christopher Columbus had followed this same route in 1492, it would have taken him about 70 da. The time taken by the liner is what per cent of the time Columbus would have taken?

10. Each year our railroads carry about 2750 million tons of freight. To do this, it takes about 25 million freight cars. This is an average of how many tons per car per year?

11. The motor truck, as well as the freight train, is an important factor in modern transportation. Some motor trucks can carry a load of 20 T. How many men, each carrying 50 lb., would it take to carry the load of such a truck?

12. If a truck carrying a load of 10 T. can travel 100 mi. in a day at a cost of $45, how much does it cost to move 1 T. a distance of 100 mi.? a distance of 1 mi.?

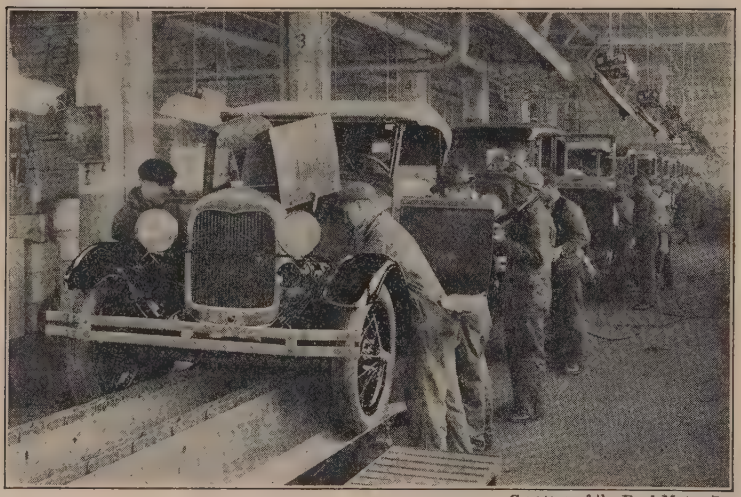
13. A man carrying 50 lb. can average 20 mi. per day. How many days will it take him to carry 1 T. a distance of 20 mi.? At $5 per day, how much will it cost? How much does it cost per ton per mile to move goods in this way?

14. The United States is a large country, and many people travel on our railroads. The total distance traveled yearly by passengers averages 36 billion miles. This is an average of how many miles for each of our 125 million people?

15. There are 250,000 mi. of railroads in our country. Texas, which has the largest number of miles of any state, has $6\frac{1}{2}\%$ of the total mileage. How many miles are there in Texas?

16. Before the invention of the steam engine, people traveled by stagecoach. In 1802, the trip from Savannah, Georgia, to Boston, Massachusetts, by stagecoach required $22\frac{1}{2}$ da. Today this trip can be made by train in 28 hr. The train's time is what per cent of that of the stagecoach?

17. In Ex. 16, the stagecoach fare from Savannah to Boston was $70. The train fare today is $39.50. The train fare is what per cent of the stagecoach fare?



Courtesy of the Ford Motor Co.

1. With about 23,130,000 automobiles in use today, the **United States has become a country of automobiles.** This is an average of one car to how many persons in our population of 125,000,000 people?

2. Taking the number of automobiles in the world as 30 million, find from Ex. 1 the per cent that the United States has.

3. In 1910 we made 187,000 automobiles and in 1927 we made 3,335,805 automobiles. What was the per cent of increase during this period?

4. About 4,000,000 men are employed in one way and another in connection with the automobile industry. This is what per cent of our population of 125,000,000?

5. The use of automobiles has led to great improvement in our roads. Of our 287,928 mi. of state highways, 163,059 mi. are surfaced roads. What per cent are surfaced?

1. Americans spend about $14,000,000,000 a year in buying and running automobiles. How much is this per person for our population of 125,000,000 people?

2. Mr. Brown buys gasoline in quantity and stores it in a tank underground. At 17¢ a gallon, how much does he pay for 150 gal.? How much does he save on 150 gal. when the filling-station price is 20¢ per gallon?

3. Mr. Brown changes the oil in the engine of his car every 500 mi. If the last time he changed the oil the speedometer registered 7546 mi., what will the speedometer register when it is time to change the oil again?

4. Mr. Brown buys motor oil in 5-gallon cans which cost $3. How much does it cost him per quart? If he had the oil put in at a garage, he would pay 25¢ a quart. What per cent of the price by the quart does he save by buying in quantity?

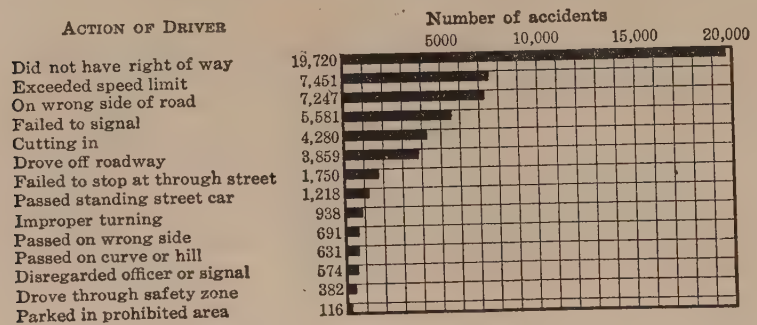
5. Before going on a long trip, Mr. Dean had the following work done on his car: removing carbon and grinding valves, $10.50; new steering knuckle, $4.50; relining and adjusting brakes, $8.75; spring fixed, $3.25; removing dents from fenders, $3.50; greasing, $1.50; washing, $2. What was the amount of Mr. Dean's bill?

6. Mr. Eastman drives 16 mi. to the city, and back again, each day in his car. How many miles does this make in a year in which he goes to the city on 304 da.?

7. Mr. Eastman's car averages 14 mi. per gallon of gasoline. At 19¢ a gallon, how much did it cost him for gasoline in a year in which he drove 15,000 mi.?

8. In Ex. 7, Mr. Eastman used 8 qt. of motor oil every 1000 mi. At 20¢ a quart, how much did the oil cost that year?

THE automobile can and should be just as safe a means of transportation as a railroad train or a trolley car. Unfortunately, however, the increasing use of the automobile has been accompanied by far too many accidents of different kinds. The National Safety Council, in studying the causes of accidents in which the driver was at fault, prepared this graph:



Give the answers to these problems to the nearest 0.1 %:

1. What was the total number of accidents covered by the report from which this graph was made?

2. In what per cent of the cases did an accident happen because the driver did not have the right of way?

From the graph, find in what per cent of the cases the driver

3. Was on the wrong side of the road.

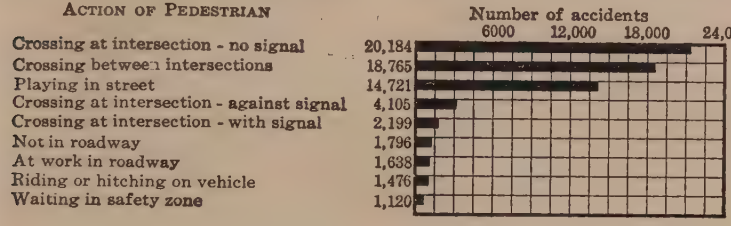
4. Failed to signal to cars behind him.

5. Was exceeding the speed limit.

6. Passed a standing street car.

7. Was "cutting in," which is a most dangerous practice.

NOT all automobile accidents are due to carelessness on the part of the driver of the car. **Many are due to the fault of those who walk or play in the streets.** This graph tells the pedestrians' side of the story about automobile accidents:



1. What was the total number of accidents covered by the report from which this graph was made?

To the nearest 0.1%, find in what per cent of the cases the person injured was

2. Crossing the street between intersections.

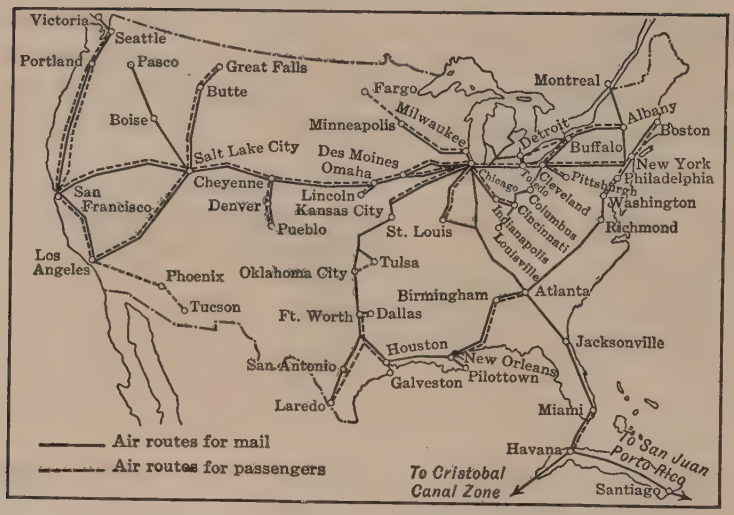
3. Crossing at an intersection where there was no signal.

4. Crossing at an intersection against a signal.

5. Playing in the street. **This is the cause of a large number of accidents to children in every city.**

6. Riding or "hitching" on a vehicle. **This is another dangerous practice, which causes many accidents to children.**

7. In New York City alone, in a recent year, there were more than 1000 people killed and 45,000 people injured by automobiles. The combined losses of the Federals and the Confederates in the battle of Bull Run were 4878. This is what per cent of the number involved in accidents in New York City?



1. This map shows some of **our important air routes.** In a recent year the number of miles flown by commercial airplanes was 5,870,480. The air-line distance from New York to San Francisco by one route is 2710 mi. The total number of miles flown that year was enough for how many round trips between New York and San Francisco?

2. New York and Chicago are 780 mi. apart by air. When the trip by airplane is made in 10 hr. 15 min., what is the average rate per hour?

3. To cover the 2710 mi. from New York to San Francisco in 30 hr., flying time, what must be the average speed?

4. The passenger fares charged by several air lines average 10.6¢ per mile. At this rate, what would be the fare from Chicago to Salt Lake City, a distance of 1400 mi.?

1. Our great ocean liners carry not only passengers but freight. In a year in which all the ports of Europe handled about 28,000,000 T. of merchandise, New York alone handled 20,500,000 T. New York handled what per cent of the merchandise handled by all the ports of Europe?

2. One of our largest steamers is 915 ft. 5 in. long. About how long is your school building? To the nearest tenth, this steamer is how many times as long as your school building?

3. One of the fastest steamers in the world made a 3073-mile trip across the Atlantic in $4\frac{3}{4}$ da. This was an average rate of how many miles per hour?

4. The weight of one of our large steamers is 64,800 T. This is how many times the weight of a boy who weighs 64.8 lb.?

5. On one trip a liner carried 2500 passengers and a crew of 375. What was the ratio of crew to passengers?

IF YOU wish to send a package from New York to San Francisco, there are several ways of doing it. You may use **freight, express, parcel post, letter post,** or **air mail,** according to (1) the weight and size of the package and (2) the time in which you wish it to get there.

1. A package can be sent by parcel post from New York to San Francisco at a cost of 13¢ for the first pound and 12¢ for each additional pound or fraction of a pound. What will be the postage on a package weighing $6\frac{1}{2}$ lb.?

2. A shipment weighing 150 lb. would probably be sent from New York to San Francisco either by express or by freight. Express is faster than freight, and so it costs more. At $12.85 for each 100 lb., what would be the express charges?

3. Railroad freight rates are higher than water freight rates. At $3.22 per 100 lb., what would be the railroad freight charges on a shipment weighing 150 lb.? At $1.50 per 100 lb., what would be the water freight charges?

4. The rate for letters is 2¢ for each ounce. Air mail costs 5¢ for the first ounce and 10¢ for each additional ounce. On a package of bonds weighing 12 oz., air mail costs what per cent more than letter post?

5. Mr. Green weighs 150 lb. Just for fun, find how much it would cost Mr. Green to send himself from New York to San Francisco by air mail (Ex. 4).

6. In Ex. 5, find how much greater the cost by air mail would be than the cost by parcel post (Ex. 1); by express (Ex. 2); by railroad freight (Ex. 3); by water freight (Ex. 3); by letter post (Ex. 4).

Our Forests

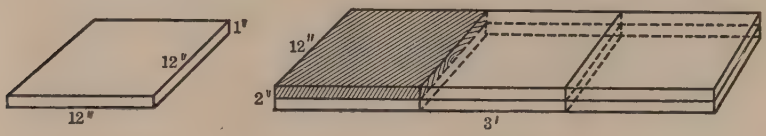
1. **Many of our forests are owned and protected by our national and state governments.** The national forests cover 160,000,000 A., and the state forests cover 6.4% as much land. Find the combined area of our national and state forests.

2. It takes 150 yr. for a sugar maple to produce a log 18 in. across, and 25 yr. for a cottonwood. Find the ratio of the growing time of a cottonwood to that of a sugar maple.

From Ex. 2, find the ratio of the growing time of each of the following trees to that of the sugar maple:

3. Red pine, 60 yr.
4. Yellow birch, 140 yr.
5. Cypress, 40 yr.
6. Hickory, 120 yr.

THE logs from the forests are sawed into boards and sold to builders by the **board foot (bd. ft.)**. This means a piece 1 ft. long, 1 ft. wide, and 1 in. (or less) thick, or its equivalent.



1 bd. ft. **6 bd. ft.**

The right-hand figure, above, shows that a 2-inch plank which is 1 ft. wide and 3 ft. long contains 6 bd. ft.; that is, the number of board feet is $2 \times 1 \times 3$, or 6.

Board feet = thickness (in.) × width (ft.) × length (ft.).

In billing lumber, a fraction of a board foot is counted as 1 bd. ft. For example, a builder might order 20 pieces of lumber, 4″ by 8″ by 10′. As here shown, there are $533\frac{1}{3}$ bd. ft., but he would be charged for 534 bd. ft.

$$20 \times \cancel{4}^{1} \times \frac{8}{\cancel{12}_{3}} \times 10 = 533\tfrac{1}{3}$$

534 bd. ft. *Ans.*

1. In the example above, where did the $\frac{8}{12}$ come from? Where did the 20 come from?

Find the number of board feet in 12 pieces, each of which is

2. 2″ by 8″ by 16′
3. 2″ by 10″ by 18′
4. 1″ by 6″ by 12′
5. 2″ by 8″ by 14′
6. 2″ by 12″ by 14′
7. 1″ by 10″ by 20′
8. 2″ by 4″ by 16′
9. 6″ by 8″ by 14′

1. The Deerslayer Club built a clubhouse for themselves. The house was 12′ wide and 20′ long, including the porch which ran across the front. What was the total area covered by the house and porch?

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2. To the scale of $\frac{1}{4}$ in. to 1 ft., draw a plan of the house, including the porch, which was 6′ wide.

3. The boys bought the following lumber: joists, 347 bd. ft. @ \$50 per M (which means per 1000 bd. ft.); floor boards, 376 bd. ft. @ \$70 per M; clapboards, 750 @ \$80 per M; roof boards, 260 bd. ft. @ \$45 per M; shingles, 2 M @ \$7 per M; nails, 16 lb. @ 8¢ and 8 lb. @ 14¢; corner and ridge boards, 63 bd. ft. @ \$100 per M. Find the total cost.

4. New windows for the house would cost \$6.50 apiece, but the boys could get secondhand ones in good condition for \$3 each. Find the per cent of saving on the windows.

5. Bob's father said that he would pay for having a fireplace built if the boys would provide the bricks. The mason estimated that he would need 100 fireplace bricks and 600 chimney bricks. At \$20 per M, how much would the bricks cost?

6. For the chimney, they also needed 10 ft. of flue lining at 60¢ a foot and 1 bbl. of lime @ \$2.50. From Ex. 5, what was the total cost of materials for the chimney and fireplace?

7. For the outside of the house they bought $2\frac{1}{2}$ gal. of paint @ \$2.50 per gallon. How much did it cost?

1. For small frame (wood) houses it is estimated that 10% of the total cost should be allowed for the architect's fee, 40% for labor, and 50% for materials. Find the amount that should be allowed for each of these purposes on a house that is to cost $7500 in all.

2. It is estimated that the amounts spent for materials for a 6-room frame house are distributed as follows: lumber, 45%; brick, cement, glass, and laths, 17.2%; plumbing, 10.3%; heating equipment, 8.4%; electric equipment, 3.6%; roofing, 5.6%; paint, 4.0%; hardware, 2.5%; miscellaneous, 3.4%. Find how much was spent for each of these purposes for a 6-room frame house for which the materials cost $3050.

3. In Ex. 2, what is the ratio of the cost of the heating equipment to the cost of the electric equipment? of the cost of the paint to the cost of the lumber?

4. In building a 6-room frame house, 50% of the cost of labor must be allowed for carpenters, while for a brick house of the same size, only 30% of the labor cost is allowed for carpenters. What is the ratio between the cost of carpenter labor for frame and brick houses?

5. In building a 6-room brick house, 20% of the total labor cost must be allowed for the bricklayers. What is the ratio of the labor cost for bricklayers for a brick house to that for carpenters for a frame house, as given in Ex. 4?

6. The cost of plastering is usually figured at so much per square yard. At 65¢ per square yard, find the cost of plastering the ceiling of a room that is 21 ft. long and 15 ft. wide.

7. At 27 cu. ft. to a load, how many loads of earth will be removed in digging a cellar 24 ft. by 30 ft. by 6 ft.?

1. In a 28-story "skyscraper" in one of our big cities the first story is 32 ft. high, and each of the other stories is 18 ft. high, including floor and ceiling in each case. Allowing 16 ft. additional for the roof, what is the total height of the building?

2. In Ex. 1, the building is 200 ft. long and 140 ft. wide. What is the area occupied by the building?

3. Building costs are often estimated by the cubic foot. At 68.4¢ per cubic foot, what would be the estimated cost of a building that is to contain 6,230,000 cu. ft.?

4. In a building that cost $6,000,000, the cost of the plumbing equipment was $40,000, and the cost of the heating and ventilating equipment was $250,000. The plumbing cost was what per cent of that of the heating and ventilating equipment? what per cent of the total cost?

5. At $2.75 per square foot per year, what would be the yearly rental of a suite of offices occupying 2500 sq. ft.?

1. Iron, from which steel is made, is found in rocks and certain kinds of soil all over the world. It is estimated that iron ore can be found in 4 % of the earth's surface. Taking the land surface of the earth as approximately 57,510,000 sq. mi., find the area containing iron ore.

2. It is estimated that 3 T. of coal are needed to make 1 T. of steel from the iron ore. For how much steel will 2575 T. of coal be sufficient?

3. In many buildings steel forms an important part of the construction. In 1870 this country produced about 70,000 long tons (2240 lb.) of steel. In a recent year we produced about 44,940,000 long tons of steel. What was the per cent of increase between these years?

4. In the same year as the last one in Ex. 3, Germany produced 16,310,000 metric tons (2205 lb.) of steel. To how many long tons was this equivalent?

5. Some of our railroads use rails that weigh 120 lb. per yard. What is the weight in pounds of the rails needed for 1 mi. of single track (two rails)?

6. From Ex. 5, find the weight in long tons of the rails needed for 100 mi. of double track (four rails).

7. In a recent year the production of iron and steel in this country was valued at 6462 million dollars, while that of other metals was 2834 million dollars. The value of the iron and steel was what per cent greater than that of the other metals? It was what per cent of the total value of all metals?

8. Of the 44,940,000 long tons of steel produced in a recent year, building construction took 4,281,000 and the railroads 5,858,000. What per cent was used for each purpose?

NOT all the metals mined in this country are used in the building industries. **There are many other uses for metals and for the compounds of metals, like steel, brass, and bronze.** We also mine each year large quantities of the precious metals like gold and silver.

1. One day the boys were wishing for big things. Fred wished for all the gold mined in this country in a year, and Frank for all the iron. We mine yearly about 50 million dollars' worth of gold and 45 million tons of iron, worth $22 a ton. Which wish represented the more money, and how much more?

2. Jack wished for all the silver that is mined in a year. We mine about 63 million ounces of silver every year. At 62.4¢ per ounce, how much is this worth?

3. Tom wished for all the copper we mine in a year, which is about 800,000 T. At 14.2¢ per pound, what is this worth?

4. Of the four wishes (Exs. 1 to 3), which represented the most money, and how much more was it than the least?

5. Lead is 11.35 times as heavy as water, and 1 cu. ft. of water weighs 62.5 lb. Find, to the nearest 0.1 lb., the weight of a lead ball that contains $1\frac{1}{2}$ cu. ft. of lead.

6. Zinc is used in the electrical industry, in photography, in plumbing, and in many metal compounds. In a recent year we mined 577,000 T. of zinc, valued at $74,000,000. What, to the nearest 0.1¢, was the average value per pound?

7. In a recent year the world's output of aluminum, which is used in the iron, electrical, automobile, and airplane industries, and in many other ways, was 200,000 T. Of this the United States produced 38%. How many tons did we produce?

1. One kind of gun metal, made of copper and tin, contains 4 parts of tin to 21 parts of copper, by weight. The copper in the compound is what per cent of the whole? The tin is what per cent of the whole?

2. Did you ever stop to think that **arithmetic can be used in adjusting the tones of bells**? The quality of the tone depends partly upon the proportions of the metals used. If a bell weighing 462 lb. contains 2 parts of zinc, 21 parts of tin, and 3 times as much copper as tin, by weight, what is the weight of each kind of metal in the bell?

3. In Ex. 2, what is the per cent of tin? of zinc? of copper?

4. Gold is almost always mixed with some other metal like copper or silver before it is used for jewelry, coins, and the like. United States gold coins contain 9 parts of gold to 1 part of copper. They contain what per cent of pure gold?

5. The purity of gold is measured in carats, **pure gold being called 24 carats fine.** The best gold commonly used in jewelry is 18 carats fine. This is what per cent pure gold?

6. If each 100 oz. of one kind of gun metal contains 14.5 oz. of tin to 85.5 oz. of copper, what quantity of tin must be melted with a block of copper weighing 427.5 lb.?

7. In Ex. 6, find the amount of copper that must be melted with $159\frac{1}{2}$ lb. of tin to form this kind of gun metal.

8. Our 1-cent pieces are made of bronze. One kind of bronze contains, by weight, 82% of copper and the rest tin. What is the ratio of the tin to the copper? of the tin to the bronze? of the copper to the bronze?

9. In Ex. 8, how many pounds of copper must be melted with 90 lb. of tin to make the bronze?

IF YOU have trouble with these examples, practice on others of the same kind until you can do them easily. Where you can do the work "in your head," write only the answer.

Find the answers:

1. $428 + 36$
2. $206 - 42$
3. 20×370
4. 15×25
5. $630 \div 9$
6. $125 \div 25$
7. 4% of 25
8. 30% of 10
9. 6% of \$120
10. $2\frac{1}{2}$% of \$100
11. $3\frac{1}{2}$% of \$150
12. $4\frac{1}{4}$% of \$400
13. $4 \times 15\frac{1}{2}$ in.
14. $3\frac{1}{7} \times 3\frac{1}{2}$ ft.
15. 3.14×3.5 ft.
16. $\frac{3}{4} \times 5280$ ft.
17. 30 gal. $\div 7\frac{1}{2}$
18. 1760 yd. $\div 5\frac{1}{2}$

Add, subtract, multiply, or divide, as indicated:

19. $2\frac{1}{2} + 3\frac{3}{4}$
20. $4 \times 3\frac{3}{4}$
21. $2\frac{1}{2} \div 2$
22. $2\frac{1}{2} \div \frac{1}{2}$
23. $2\frac{1}{2} \div 1\frac{1}{4}$
24. $1\frac{1}{2} \times 2$
25. $1\frac{1}{2} \times \frac{1}{2}$
26. $1\frac{1}{2} \times 2\frac{1}{2}$
27. $3\frac{3}{4} \times 3\frac{1}{2}$
28. $3\frac{1}{7} \times 21$
29. $1\frac{1}{2} + 2\frac{1}{4} + 1\frac{3}{4}$
30. $2\frac{1}{3} + 2\frac{2}{3} + 3\frac{7}{8}$
31. $3\frac{1}{2} + 2\frac{1}{4} - 2\frac{3}{4}$
32. $5\frac{3}{8} - 2\frac{1}{2} + 1\frac{1}{4}$
33. $2\frac{1}{6} + 3\frac{1}{2} - 4\frac{1}{3}$

Find the missing numbers:

34. $6 \times 0.7 =$ ——
35. $0.6 \times 7 =$ ——
36. $0.6 \times 0.7 =$ ——
37. 4% of $5 =$ ——
38. 25% of $\frac{1}{8} =$ ——
39. $\frac{5}{50} =$ —— %
40. $125 =$ —— %
41. 6% is $\frac{4}{5}$ of ——
42. $2\frac{1}{4}$ is —— % of 45
43. 10% of 1 mi. = —— ft.

1. A salesman sells $8\frac{3}{4}$ yd. from a roll of velvet that contains $68\frac{1}{8}$ yd. How much cloth is left?

2. On some bridges, people have to pay toll to go across. The toll on one bridge is 5¢ for an automobile and the driver, and 5¢ for each passenger. What is the total toll for a car with 4 people and a driver?

3. If Grace does 48 examples correctly in a test containing 60 examples, what per cent does she do correctly?

4. If John's scores on 5 arithmetic tests were 80, 72, 78, 89, and 93, what was his average score?

5. Mr. Jencks used $4\frac{1}{2}$ gal. of gasoline in driving 50 mi. At this rate, how much would he use in 625 mi.?

6. The rates charged by a taxicab company are 15¢ for the first $\frac{1}{3}$ mi. (or any smaller fraction) and 10¢ for each $\frac{1}{3}$ mi. thereafter. What would be the fare for $2\frac{1}{3}$ mi.?

7. Mrs. Brown bought at 25% off a dress that had been marked $45. How much did she pay for it?

See how quickly you can do these examples:

8. $37\frac{1}{2}\%$ of $48 =$ ——

9. $2\frac{1}{2} \times 3\frac{1}{4} \times 1\frac{1}{8} =$ ——

10. $\frac{3}{4}$ is ——% of 4

11. $2\frac{3}{8} \div 2\frac{1}{8} =$ ——

12. $\frac{3}{4} = 2\frac{1}{2} \times$ —— $\times \frac{3}{5}$

13. $1\frac{1}{3} \times 4\frac{1}{2} = 2 \times$ ——

14. $102 = 24\%$ of ——

15. 50 is ——% of 150

16. $100 =$ ——% of 200

17. ——% of $270 = 18$

18. $2 \times 0.06 \times \$150 =$ ——

19. $3 \times 0.04 \times \$200 =$ ——

20. $1\frac{1}{2} \times 0.05 \times \$400 =$ ——

21. $2\frac{1}{2} \times 0.04\frac{1}{2} \times \$600 =$ ——

CHAPTER SIX

KNOWLEDGE AND FINANCE

I. HOW KNOWLEDGE IS SPREAD

Then and Now

OUR nation has not always been as large as it is now. If it had been when George Washington was elected president in 1789, it would have taken many weeks for people in New York to find out what was happening in San Francisco. **In those days knowledge was spread largely by riders on horseback.**

1789

1928

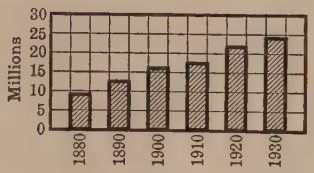
When Herbert Hoover was elected president in 1928, the crowds gathered in New York on the night of election day were told by the radio how the people of San Francisco had voted. **Today knowledge is spread almost instantly by means of the telegraph, the telephone, and the radio.**

When President Washington gave his inaugural address, probably not more than 500 people could hear him distinctly. When President Hoover gave his address, his voice was carried to every part of the country by the radio, and it is estimated that at least 60,000,000 people heard him with ease.

How Our Schools have Grown

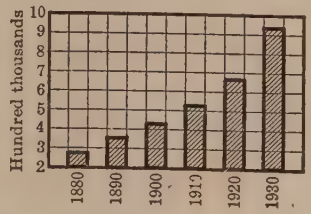
WHEN George Washington was your age, there were almost no public schools. **Today there are thousands of fine school buildings all over the country.** These graphs tell the story of how our schools have helped to spread knowledge.

1. This graph shows how the **number of pupils** enrolled in our public schools has increased since 1880. From the graph, estimate as closely as you can the number of pupils that there were in the public schools at each of the six periods covered by the graph.



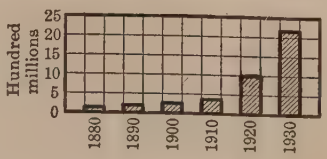
2. In Ex. 1, about how many million more pupils were there in 1930 than in 1880?

3. This graph shows how the **number of teachers** in our public schools has grown since 1880. Estimate the number of teachers that there were at each period.



4. In Ex. 3, about how many hundred thousand more teachers were there in 1930 than in 1880?

5. This last graph shows how the **cost of our public schools** has increased since 1880. Estimate from the graph the cost in 1910; in 1920; in 1930.



6. Estimating the number of pupils from the graph in Ex. 1, find for each of the years 1910, 1920, and 1930 the approximate cost of our public schools per pupil.

1. A table of products gives the product of 132×148 as 19,536 and that of 108×927 as 100,116. Without multiplying, write the product of 132×14.8; of 1.08×927.

As in Ex. 1, write these products without multiplying:

2. 1.48 132	**3.** 13.2 1.48	**4.** 9.27 10.8	**5.** 0.148 1.32	**6.** 92.7 1.08
7. 1.32 14.8	**8.** 1.08 9.27	**9.** 1.48 1.32	**10.** 0.108 0.927	**11.** 14.8 13.2

See how quickly you can do these multiplications:

12. 798 1.5	**13.** 46.3 35.7	**14.** 36.4 1.04	**15.** 9.87 92.8	**16.** 4264 0.58
17. 1.28 6.14	**18.** 5.41 80.9	**19.** 8674 24.7	**20.** 1024 15.6	**21.** 4856 8.07
22. 57.9 14.6	**23.** 2645 0.23	**24.** 3091 0.407	**25.** 12.5 0.075	**26.** 12.34 1.08
27. 3080 0.139	**28.** 9521 9.32	**29.** 278.9 0.753	**30.** 5280 0.687	**31.** 5.076 82.9

See how quickly you can do these divisions:

32. $50\overline{)\$67.00}$	**36.** $207\overline{)\$306.36}$	**40.** $1.05\overline{)135.051}$
33. $80\overline{)\$96.00}$	**37.** $304\overline{)\$431.68}$	**41.** $7.56\overline{)624.078}$
34. $89\overline{)\$85.44}$	**38.** $128\overline{)\$583.68}$	**42.** $12.25\overline{)202.615}$
35. $98\overline{)\$70.56}$	**39.** $283\overline{)\$931.07}$	**43.** $45.07\overline{)4425.874}$

IF YOU will stop to think of the millions of newspapers, magazines, and books that are printed in this country, you will realize why **the modern printing press is the most important factor in spreading knowledge.**

1. More than 40,000,000 newspapers are printed every day. To the nearest whole number, this is one paper for how many persons in our population of 125,000,000?

2. Miss West took her class to see a modern newspaper office. They saw one press that printed, cut, folded, and delivered 15,000 papers per hour. If the press runs an average of $10\frac{1}{2}$ hr. per day, how many papers will it print in 6 da.?

3. The foreman of the pressroom said that for all the presses it took 120 lb. of ink per day. How many tons of ink do the presses use in a year when they run 312 da.?

4. The Little News Shop sold 300 magazines last month. In the whole country, about 120,000,000 magazines are sold each month. The shop's sales were what per cent of the total?

5. One magazine that is published every week charges $8000 for a full-page advertisement that is to appear in the copies printed for that week. How much will it cost to run a full-page advertisement for a year (52 wk.) in this magazine?

6. There are more than 200,000,000 books printed every year in this country, and 28,000,000 of them are textbooks. What per cent of the books are textbooks?

7. The author of a book is often paid a **royalty** (commission) based on the amount received by the publishers from the sale of the book. At 15%, how much will the author receive from the sale of 42,000 copies at $1.60 per copy?

IN DOING these examples, **you are not to use pencil and paper.** See how quickly you can give the answers or can find the incorrect ones in the cases where answers are given.

See if you can find all the incorrect answers:

1.	2.	3.	4.	5.
720	575	25)750	450	400
− 36	+ 125	300	× 20	× 6%
684	700		9000	240

See if you can give the correct answers orally:

6.	7.	8.	9.	10.
$9.27	$4.80	5)125	35¢	$360
+ .42	− 1.50		× 3	× 0.02

See if you can do these multiplications "in your head":

11.	12.	13.
2 ft. 6 in.	2 hr. 15 min.	5 lb. 4 oz.
2	3	8

Tell which of these statements are incorrect:

14. $4\% = 0.04$
15. 4 ft. = 48 in.
16. 4 yd. = 16 ft.
17. 4 hr. = 240 sec.
18. $5 = 500\%$
19. $250\% = 25$
20. 8% of $8 = 64\%$
21. $8\% \div 16\% = \frac{1}{2}\%$

See if you can do these divisions "in your head":

22. $\frac{1}{4} \div 4$	26. $\frac{1}{2} \div 4$	30. $2\% \div 2\%$
23. $\frac{3}{8} \div 2$	27. $\frac{1}{2} \div \frac{1}{4}$	31. $2 \div 2\%$
24. $\frac{3}{8} \div 3$	28. $\frac{1}{4} \div \frac{1}{2}$	32. $2\% \div \frac{1}{2}$
25. $2\frac{1}{2} \div 1\frac{1}{4}$	29. $9\frac{3}{4} \div 3\frac{1}{4}$	33. $200\% \div 20$

1. Here is a picture of the presses that printed this book. Each press can print 1200 copies of this page per hour. How long would it take one press to print 100,000 copies?

2. The book is printed on large sheets of paper which are later folded and cut to the size of this page. If each sheet folds into 64 pages, how many sheets does it take for each copy of a book in which there are 448 pages? How many sheets will it take to print 100,000 copies?

3. To print 100,000 copies of this book, it takes 220 cases of paper, each of which contains about 550 lb. of paper. How many tons of paper does it take in all?

4. In sewing the pages together, it takes 39 in. of thread per book. How many yards does it take for 100,000 copies?

5. It takes 104 sq. in. of cloth to make the cover of this book. How many square feet are needed for 100,000 copies?

See if you can do all these additions correctly:

1.	2.	3.
17 lb. 4 oz.	28 ft. 9 in.	8 yd. 20 in.
9 lb. 8 oz.	12 ft. 7 in.	4 yd. 30 in.

See if you can do all these subtractions correctly:

4.	5.	6.
3 hr. 20 min.	2 da. 16 hr.	7 mo. 21 da.
1 hr. 45 min.	1 da. 10 hr.	3 mo. 26 da.

Find the difference in time between these dates:

	yr.	mo.	da.		yr.	mo.	da.		yr.	mo.	da.
7.	1936	11	4	8.	1939	1	12	9.	1941	3	7
	1932	6	8		1933	7	6		1934	7	14

See if you can do all these multiplications correctly:

10.	11.	12.
3 ft. 7 in.	4 lb. 9 oz.	3 yd. 16 in.
2	7	9

See if you can do all these divisions correctly:

13. 5)6 ft. 3 in.
14. 8)9 yd. 4 in.
15. 5)8 yd. 7 in.
16. 8)39 lb. 8 oz.
17. 4)13 lb. 4 oz.
18. 6)52 bu. 2 pk.
19. 4)5 hr. 8 min.
20. 5)8 hr. 0 min.
21. 6)9 hr. 6 min.

Find these per cents:

22. 10% of 2 ft. 6 in.
23. 200% of 17 ft.
24. 100% of 3.4 in.
25. 75% of 8 ft. 8 in.
26. 50% of 3 yd. 18 in.
27. 75% of 9 ft. 4 in.
28. 7.5% of 94 ft.
29. 25% of 9 hr. 20 min.

1. Edison invented the talking machine in 1877 and the moving-picture machine in 1893. Today we have the "talking pictures" which millions of people see every day. How many years is it since the invention of each machine?

2. The pictures on this film are $\frac{3}{4}$ in. high, and were taken at the rate of 16 per second. How many feet of film were used in 20 min.?

3. The usual length of film on a reel is 1000 ft. At 16 pictures per second, how long will it take to show a reel?

4. At 8 pictures per second, how long will it take to show 200 ft. of "slow-motion" film?

5. The total width of the film shown above is $1\frac{1}{16}$ in. How many square feet are there in a 1000-foot reel of it?

1. Maud bought a folding camera, originally marked \$8.25, at a discount of $33\frac{1}{3}\%$. How much did she pay for it?

2. In buying films for her camera, Maud can buy a roll containing 8 "exposures" (a roll that will give 8 pictures) for 25¢, or one containing 12 exposures for 35¢. How much can she save per picture by buying the 12-exposure rolls?

3. If Maud buys a dozen 12-exposure rolls at a time, the price is \$3.60. To the nearest 0.1%, what per cent of the price in Ex. 2 can she save in buying by the dozen?

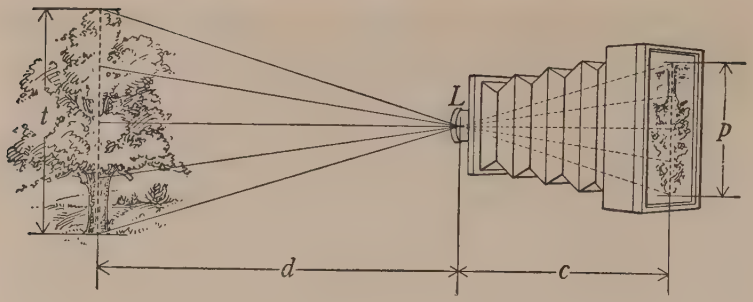
4. Maud pays 15¢ for having a roll of film developed, and 4¢ apiece for each print from it. How much does it cost to develop and print 2 pictures each from a 12-exposure roll?

5. For the size of camera that George has, a 12-exposure film costs 45¢. It costs 20¢ for developing the film, and 6¢ for each picture printed. On the last roll that George had developed, he ordered 1 print of each picture. If 2 of the pictures were spoiled because he moved while taking them, how much did it cost apiece for each of the good pictures?

6. Maud's camera takes a picture that is $1\frac{1}{2}$ in. by $2\frac{1}{2}$ in., and George's camera takes one that is $2\frac{1}{4}$ in. by $3\frac{1}{4}$ in. The area of one of George's pictures is how many times that of one of Maud's pictures?

7. From one of her pictures that was $1\frac{1}{2}$ in. by $2\frac{1}{2}$ in., Maud had an "enlargement" made. The enlarged picture was 6 in. by 10 in. The area of the enlarged picture was how many times that of the small picture from which it was made?

8. It cost George \$1.30 to have an enlargement 13 in. by 9 in. made from one of his small pictures. To the nearest 0.1¢, how much per square inch did the enlarged picture cost?



WHEN Maud takes a picture with her camera, she first opens it up so that the lens L, as shown in the diagram above, is at the distance c from the film on which the picture is to be taken.

The diagram also shows how the rays of light from the tree, which is at the distance d from L, cross each other in passing through the lens, so that the picture on the film is upside down. When the picture is printed, Maud simply turns it around.

In taking the picture, **the ratio of the height p of the picture to the distance c is equal to the ratio of the height t of the tree to the distance d; that is,**

$$\frac{p}{c} = \frac{t}{d}.$$

Two ratios that are equal to each other are said to form a **proportion.** The four numbers which the letters represent are said to be **proportional** or to be **in proportion.**

In the above proportion, p and c represent lengths that would ordinarily be given in inches, and d and t represent lengths that would be given in feet. **Both terms of each ratio must always be numbers of the same kind.** The ratio of 4 in. to 2 ft. is not $\frac{4}{2}$; it is $\frac{4}{24}$, or $\frac{1}{6}$ in its simplest form.

SUPPOSE that in Maud's camera the length of c is 5 in. and that the tree is 20 ft. high and 40 ft. from the lens L. That is, in this case, $c = 5$, $t = 20$, and $d = 40$.

The proportion given on the opposite page therefore becomes

$$\frac{p}{5} = \frac{20}{40}.$$

$$\frac{p}{5} = \frac{20}{40}$$
$$\tfrac{1}{5}\,p = \tfrac{20}{40} = \tfrac{1}{2}$$
$$p = 5 \times \tfrac{1}{2} = 2\tfrac{1}{2}$$

As shown in the work above, this means that $\frac{1}{5}\,p = \frac{1}{2}$; whence $p = 2\frac{1}{2}$. Since c represents inches, the picture of the tree will be $2\frac{1}{2}$ in. high.

1. What does $\frac{p}{c} = \frac{t}{d}$ become when $c = 6$ in., $t = 20$ ft., and $d = 30$ ft.? What is the height p of the picture?

Find the value of p in the proportion of Ex. 1 when

2. $c = 4''$, $t = 18'$, $d = 24'$
3. $c = 5''$, $t = 20'$, $d = 50'$
4. $c = 4''$, $t = 30'$, $d = 40'$
5. $c = 6''$, $t = 4'$, $d = 16'$
6. $c = 8''$, $t = 16'$, $d = 32'$
7. $c = 6''$, $t = 10'$, $d = 48'$

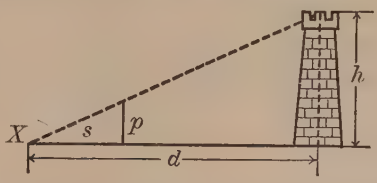
8. When $p = 3$ in., $c = 7$ in., and $d = 35$ ft., the proportion $\frac{p}{c} = \frac{t}{d}$ becomes $\frac{3}{7} = \frac{t}{35}$, which means that $\frac{1}{35}\,t = \frac{3}{7}$. What is the value of t? How high is the tree?

Find the value of t in the proportion of Ex. 8 when

9. $p = 2''$, $c = 6''$, $d = 48'$
10. $p = 3''$, $c = 8''$, $d = 64'$
11. $p = 4''$, $c = 6''$, $d = 36'$
12. $p = 5''$, $c = 8''$, $d = 28'$
13. $p = 6''$, $c = 10''$, $d = 65'$
14. $p = 8''$, $c = 12''$, $d = 24'$

PROPORTION can be used in solving many other kinds of problems. For example, this picture shows how a class used proportion to find the height h of a tower near the school.

One boy held a 10-foot pole p upright, while a second boy found a point X on the ground from which he could just see the top of the tower over the top of the pole.



The class then measured the distance d from X to the center of the tower and found it to be 60 ft.; that is, $d = 60$. They also measured the distance s from X to the pole and found it to be 20 ft.; that is, $s = 20$. They then found the height h by arithmetic, making use of the fact that

If two figures have the same shape, their corresponding sides are proportional.

In this case, the two figures are the two triangles in which h and d of the large triangle are the sides corresponding to p and s of the small triangle; that is,

$$\frac{h}{d} = \frac{p}{s}.$$

In this case, the class then had

$$\frac{h}{60} = \frac{10}{20},$$

$$\frac{h}{60} = \frac{10}{20}$$
$$\tfrac{1}{60}\,h = \tfrac{10}{20} = \tfrac{1}{2}$$
$$h = 60 \times \tfrac{1}{2} = 30$$

from which, as shown in the work above, they easily found that $h = 30$. Since d was measured in feet, this means that the height h of the tower was 30 ft.

In working with ratios, remember that both terms of a ratio must be numbers of the same kind.

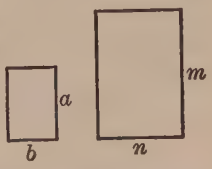
1. The class was very much interested in finding heights by the method used on the opposite page. In measuring the height of the school building, they found that $d = 48$ ft., $p = 10$ ft., and $s = 15$ ft. How high was the school building?

This table shows other measurements that the class made in finding heights. Find the numbers that belong in column h:

	d	p	s	h
2.	36′	10′	15′	
3.	16′	8′	4′	
4.	20′	5′	4′	
5.	27′	10′	18′	

	d	p	s	h
6.	18′	8′	10′	
7.	50′	8′	5′	
8.	60′	10′	16′	
9.	82′	12′	32′	

10. In making photographic enlargements, the enlargement and the original picture have the same shape. For these figures you can write the proportion $\frac{m}{n} = \frac{a}{b}$. If $a = 3$ in., $b = 2$ in., and $n = 4$ in., what is the length of m?



Here are some other measurements of pictures and enlargements. Find the numbers that belong in the blank columns:

	a	b	n	m
11.	6″	4″	8″	
12.	5″	2″	5″	
13.	6″	3″	7″	
14.	6.5″	2.4″	7.2″	

	a	b	n	m
15.		4″	8″	12″
16.		4″	6″	$10\frac{1}{2}$″
17.		5″	$7\frac{1}{2}$″	12″
18.		3.5″	10.5″	18.9″

Mail plane Mail car Mail truck Mail carrier

THE United States postal service helps to spread knowledge to all parts of the country. Here are some facts about mailing letters and packages that everyone needs to know:

1. The rate for **first-class mail** (letters or other sealed matter) to be delivered in this country, Canada, Great Britain, and certain other countries is 2¢ per ounce or fraction thereof.

To countries not having the 2-cent rate, the rate is 5¢ for the first ounce and 3¢ for each additional ounce.

Post cards for delivery in this country require 1¢ each.

2. The rate for **air mail** is 5¢ for the first ounce and 10¢ for each additional ounce or fraction thereof.

3. **Second-class mail** includes newspapers and magazines, which are sent at special rates by the publishers. When mailed by individuals, the rate is 1¢ for each 2 oz. or fraction thereof.

4. **Third-class mail** includes circulars, printed matter, and merchandise, up to 8 oz. The rate is $1\frac{1}{2}$¢ for each 2 oz.

5. **Special-delivery** rates on first-class matter are 10¢ up to 2 lb., 20¢ for 2 lb. to 10 lb., and 25¢ for over 10 lb.

6. Mail may be **registered,** so as to secure payment in case of loss, by paying a fee of 15¢ on a value up to $50, 20¢ for $50 to $100, and so on according to the value.

FOR distances in this country up to 300 mi. from the point of mailing, packages weighing up to 70 lb. may be sent by **parcel post** (fourth-class mail), and for distances over 300 mi. the limit is 50 lb. The rates vary according to the **zone** (the distance) to which the package is to go, as shown in this table:

Zone Number	Distance from Point of Mailing	First Pound	Additional Pounds
Local	Same post office	7¢	1¢ each 2 lb.
1 and 2	Up to 150 mi.	7¢	1¢ per pound
3	150 mi. to 300 mi.	8¢	2¢ per pound
4	300 mi. to 600 mi.	8¢	4¢ per pound
5	600 mi. to 1000 mi.	9¢	6¢ per pound
6	1000 mi. to 1400 mi.	10¢	8¢ per pound
7	1400 mi. to 1800 mi.	12¢	10¢ per pound
8	Over 1800 mi.	13¢	12¢ per pound

By payment of a **special-handling** fee of 10¢ for parcels under 2 lb., of 15¢ for 2 lb. to 10 lb., and 20¢ for over 10 lb., packages will be handled and delivered like first-class mail. **Special delivery** may be secured by paying an additional fee of 15¢ up to 2 lb., 25¢ for 2 lb. to 10 lb., and 35¢ for over 10 lb.

1. Find the cost of sending a package weighing 25 lb. to a place in the local zone; in each of the other zones.

2. To a place in zone 6, what is the cost of sending, special handling, a package that weighs 2 lb.? 8 lb.? 45 lb.?

3. Find the cost of sending by air mail, special delivery (see page 322), a sealed package (first-class mail) that weighs 8 oz.; 24 oz.; 32 oz.

4. To a place in zone 8, how much more does it cost to send a 5-pound package by air mail instead of by parcel post?

Thinking of 5 as $\frac{10}{2}$, multiply in each case by 5:

1. 24	3. 56	5. 28	7. 96	9. 148	11. 1620
2. 42	4. 74	6. 48	8. 78	10. 286	12. 2446

Using a short cut, multiply in each case by 50:

13. 16	15. 44	17. 18	19. 19	21. 236	23. 1844
14. 26	16. 62	18. 58	20. 79	22. 342	24. 3606

Thinking of 25 as $\frac{100}{4}$, multiply in each case by 25:

25. 12	27. 36	29. 44	31. 56	33. 324	35. 1684
26. 24	28. 32	30. 84	32. 72	34. 480	36. 1768

Thinking of 125 as $\frac{1000}{8}$, multiply by 125:

37. 24	39. 64	41. 16	43. 96	45. 168	47. 2480
38. 56	40. 72	42. 88	44. 32	46. 336	48. 3464

Using a short cut, multiply in each case by 500:

49. 14	51. 22	53. 34	55. 52	57. 124	59. 3716
50. 18	52. 28	54. 46	56. 74	58. 396	60. 5972

Thinking of "$\div 5$" as "$\times \frac{2}{10}$," divide in each case by 5:

61. 5	63. 80	65. 35	67. 90	69. 120	71. 1115
62. 15	64. 70	66. 45	68. 95	70. 230	72. 2340

Thinking of "$\div 25$" as "$\times \frac{4}{100}$," divide in each case by 25:

73. 125	75. 625	77. 180	79. 465	81. 1275
74. 325	76. 750	78. 230	80. 832	82. 7936

1. The telephone and the telegraph are important agencies in spreading knowledge. Of the 30 million telephones in use in the world, the United States has about 18 million. What per cent of all the telephones are in the United States?

2. It is estimated that there were about 35 billion telephone conversations in the world in a recent year, and of this number about 24 billion took place in the United States. What per cent took place in the United States?

3. In the same year as in Ex. 2, about 495,000,000 telegrams were sent in the world, of which about 215,000,000 were sent in the United States. What per cent of all the telegrams were sent in the United States?

4. The regular day-message rate for telegrams from New York to Chicago is 60¢ for 10 words and $3\frac{1}{2}$¢ for each additional word. How much does it cost for a 28-word message?

5. The day-time telephone rate from New York to Chicago is \$3 for the first 3 min. and \$1 for each additional minute. How much will a 7-minute conversation cost?

6. A 50-word night letter can be sent from New York to San Francisco for \$1.20. The day rate for a 10-word message is \$1.20 and $8\frac{1}{2}$¢ for each additional word. The cost per word of a night letter is what per cent of that of a 50-word day message?

7. The cable rate from New York to London is 20¢ per word for a day message. A night letter of 25 words can be cabled for \$1.20. What per cent of the day-message cost is saved by sending a 25-word message as a night letter?

8. A wireless telephone conversation between New York and London costs \$45 for the first 3 min. and \$15 for each additional minute. What is the cost of a 7-minute conversation?

Without using pencil or paper, find these per cents:

1. 2% of \$500
2. 3% of \$400
3. 6% of \$200
4. 1% of \$25
5. 5% of \$40
6. 9% of \$10
7. 10% of \$5
8. 20% of \$5
9. 50% of \$9

Without using pencil or paper, find 8% of

10. \$1
11. \$3
12. \$7
13. \$9
14. \$40
15. \$60
16. \$100
17. \$800
18. \$600
19. \$2000

Without using pencil or paper, tell what \$1.50 becomes when it is increased by these per cents of itself:

20. 1%
21. $\frac{1}{2}$%
22. 2%
23. 4%
24. 10%
25. 50%
26. $33\frac{1}{3}$%
27. $66\frac{2}{3}$%
28. 100%
29. 150%

Find the missing numbers:

30. 24 is ——% of 48
31. 48 is ——% of 24
32. 12 is ——% of 48
33. $\frac{1}{2}$ is ——% of 1
34. $\frac{1}{2}$ is ——% of $\frac{1}{2}$
35. $\frac{1}{4}$ is ——% of $\frac{3}{4}$
36. 125 is ——% of 100
37. 75 is 50% of ——
38. 50 is 50% of ——
39. 25 is 25% of ——
40. 900 is 75% of ——
41. 16 is $12\frac{1}{2}$% of ——
42. 30 is $16\frac{2}{3}$% of ——
43. 450 is $1\frac{1}{2}$% of ——
44. 0.06 is 1% of 6% of what number?
45. 1.20 is 2% of 5% of what number?
46. 60 is what number increased by 25% of itself?
47. 380 is what number decreased by 5% of itself?

AS YOU already know, **it is always a good plan to estimate the answer to a problem before you solve it.** For example, in finding the number of acres of improved land (land that is no longer wild) in this country when it is given that 26% of our 1903 million acres are improved, you can think,

"26% is a little more than 25%, or $\frac{1}{4}$. My answer should be somewhat larger than 476 million acres."

Then solve by finding 26% of 1,903,000,000 in the usual way, and compare the result with your estimate.

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1. Since 17% is just a little larger than $16\frac{2}{3}$%, what fraction would you use in estimating 17% of \$1296? What is your estimate? What is the correct answer?

For each of these per cents state the approximate per cent and the equivalent fraction that you would use in estimating:

2. 9%	7. 51%	12. 15%	17. 12%	22. 25.3%
3. 11%	8. 74%	13. 52%	18. 33%	23. $24\frac{7}{8}$%
4. 19%	9. 79%	14. 73%	19. 39%	24. $33\frac{1}{2}$%
5. 24%	10. 76%	15. 77%	20. 63%	25. 66.7%
6. 49%	11. 81%	16. 82%	21. 83%	26. 75.3%

In each of these cases first write your estimate of the answer and then find the answer:

27. 24.8% of \$720
28. 32.9% of \$8.46
29. 49.2% of 1760 yd.
30. 36.8% of 73,600 sq. mi.
31. 50.7% of \$2500
32. 76% of \$33.20
33. 62% of \$17.60
34. 13.2% of \$160,000

1. The radio is one of the newest and most popular means of spreading knowledge. It is estimated that in this country there are about 11,031,000 radio sets in use. To the nearest whole number, this is one set for how many persons in our population of 125,000,000?

2. It is also estimated that only 2.9% of the sets mentioned in Ex. 1 are of the old-style crystal type. About how many crystal sets are there?

3. The waves sent out by the broadcasting stations are measured in meters. **A meter is equivalent to 39.37 in.** How many feet long is a 740-meter wave?

4. In buying a new radio set, Mr. Lane finds that he can either pay $35 down and the balance in 10 monthly payments of $7.50 each, or he can pay $96.50 in cash. What per cent of the installment price can he save by paying cash?

THE Reeds live in St. Louis. One night while the children were listening over the radio to some music that was coming from a station in New York, they heard the announcer say that it was 8 P.M. The Reeds' clock said 7 P.M.

Mary Reed had studied geography, and so she knew that **the longitude of places on the earth is measured in degrees (°) and minutes (′) like angles.** The longitude of Greenwich, England, is 0°.

Since the earth revolves once a day, in 1 hr. it turns through $\frac{1}{24}$ of 360°, or 15°, of longitude. Remember this:

1° of longitude corresponds to $\frac{1}{15}$ hr., or 4 min.

1′ of longitude corresponds to $\frac{1}{60}$ of 4 min., or 4 sec.

The longitude of St. Louis is approximately 90° west; that is, St. Louis is 90° west of Greenwich, England (0°). This means a **difference in time** of $90 \times \frac{1}{15}$ hr., or 6 hr.

The people of Greenwich see the sun **before** the people of St. Louis do, and so the clocks in Greenwich **are ahead** of the clocks in St. Louis. If it is 6 A.M. when the sun rises in Greenwich, it is only midnight (12 o'clock) in St. Louis.

Clocks are always faster to the east and slower to the west.

This table shows how the time changes for each 15° of longitude that you go east or west from the place where you live:

WEST ←				☼ Noon Where You Live	→ EAST			
60°	45°	30°	15°		15°	30°	45°	60°
8 A.M.	9 A.M.	10 A.M.	11 A.M.		1 P.M.	2 P.M.	3 P.M.	4 P.M.

T

THIS map shows how the United States is divided into four sections **so that each section can use the same time.** It also explains why at 7 P.M. in St. Louis the Reed children heard the radio announcer say that it was 8 P.M. in New York.

Each section takes as its **standard time** the time of a certain **meridian** (north-and-south line), as shown on the map. Thus, when it is 8 P.M. by Eastern time (75° W.), it is 7 P.M. by Central time (90° W.), 6 P.M. by Mountain time (105° W.), and 5 P. M. by Pacific time (120° W.).

1. What time is it now by your school clock? What time is it now in Maine? in Iowa? in Montana? in California?

2. At 3 P.M. in Colorado, what time is it in Florida? in Arkansas? in Nevada? in Montana?

3. At what time would a radio program that starts in Los Angeles at 8 P.M. be received in Boston? in Chicago?

4. If a train leaving New York at 3 P.M. takes 22 hr., actual time, to reach Chicago, at what time will it arrive there?

5. A New York business man sent a telegram to a San Francisco firm at 3:20 P.M. The telegram was received in San Francisco at 1:50 P.M. How many minutes, actual time, was it before the telegram was received in San Francisco?

Clocks are faster to the east and slower to the west.

6. Great Britain, France, Spain, and Belgium use as standard time the time of Greenwich, England (0°). Germany, Switzerland, Denmark, Sweden, and Italy use as standard time the time of 15° E. Are the clocks in these last five countries ahead or behind the clocks in London? How much?

7. Philadelphia uses Eastern standard time, which is the time of 75° W. Are the clocks in Philadelphia faster or slower than those in London? How much?

8. Alaska uses the time of 150° W. When it is midnight in Alaska, what time is it in Washington, D.C.? in London?

9. Suppose that a radio program starts in London at 7 P.M. Assuming that the program can be received, at what time will it be received in Germany? in New York? in California?

10. When an announcer on the radio in Denver says that it is 7 P.M., what time is it in London? in Berlin?

11. During the summer months many American cities use **daylight saving time**, which is 1 hr. faster than the standard time of each section. When it is 5 P.M., Eastern daylight saving time, what time is it by Pacific standard time?

CHICAGO uses Central standard time, which is the time of 90° W. The longitude of Chicago is about 87° 37′ W., and the **local time of Chicago** is the time of this meridian. How much does local time differ from standard time?

Longitude		Time	
90°	← Standard meridian	4 min.	4 sec.
− 87° 37′	← Local meridian	× 2	× 23
2° 23′	← Difference	8 min.	92 sec.

8 min. 92 sec. = 9 min. 32 sec. *Ans.*

Chicago local time is 9 min. 32 sec. **faster** than Central standard time. Local time is not used for ordinary purposes. Can you see why? Knowing about local time, however, will help you to understand better about standard time.

1. New York City uses Eastern standard time (75° W.). Taking the longitude of New York as 73° 58′ W., find how much faster or slower the local time is than standard time.

Find the difference in time corresponding to a difference of

2. 3° 10′
3. 2° 14′
4. 8° 17′
5. 10° 24′
6. 28° 35′
7. 60° 40′
8. 73° 9′
9. 89° 27′

Find the difference in longitude corresponding to

10. 4 hr. 4 min. 4 sec.
11. 2 hr. 8 min. 12 sec.
12. 4 hr. 20 min. 32 sec.
13. 3 hr. 0 min. 40 sec.
14. 2 hr. 10 min. 20 sec.
15. 5 hr. 30 min. 24 sec.

Give the missing numbers:

1. 2 yd. = —— ft.
2. 2 ft. = —— in.
3. $\frac{1}{2}$ yd. = —— ft.
4. $\frac{1}{4}$ yd. = —— in.
5. 1 mi. = —— ft.
6. 6 in. = —— ft.
7. $\frac{1}{2}$ lb. = —— oz.
8. 10 lb. = —— oz.
9. 1 T. = —— lb.
10. $\frac{1}{4}$ T. = —— lb.
11. 4 gal. = —— qt.
12. 1 cu. yd. = —— cu. ft.
13. 1 sq. ft. = —— sq. in.
14. 2 sq. yd. = —— sq. ft.

Find the area of a rectangle which is

15. 3 ft. by 2 ft.
16. $2\frac{1}{2}$ ft. by 4 ft.
17. 10 in. by 8 in.
18. $1\frac{1}{2}$ yd. by 2 yd.

Reduce to feet:

19. 36 in.
20. 29 yd.
21. 144 in.
22. 3 mi.

Reduce to yards:

23. 144 ft.
24. 144 in.
25. 54 in.
26. $46\frac{1}{2}$ ft.

Reduce to pounds:

27. 128 oz.
28. $8\frac{1}{2}$ T.
29. 168 oz.
30. $3\frac{3}{4}$ T.

Reduce to square feet:

31. 72 sq. in.
32. 72 sq. yd.
33. 648 sq. in.

Reduce as indicated:

34. 17 cu. yd. to cubic feet.
35. 17 gal. to quarts.

To \$147.86 add the difference between \$431.07 and

1. \$49.68 2. \$306.09 3. \$4.60 4. \$258.17

From \$1702.60 take the sum of \$129.37 and

5. \$870.63 6. \$38.64 7. \$49.72 8. \$1072.40

Multiply \$43.68 by the product of $4\frac{1}{2}$ and

9. 36 10. $3\frac{1}{2}$ 11. $7\frac{1}{4}$ 12. 2.8 13. 0.16

Divide \$518.40 by the product of 1.2 and

14. 14.4 15. 2.88 16. 27 17. 8.1 18. 172.8

Add:

19.
148,372
167,009
610,898

20.
5868.99
5999.04
8867.71
7304.79

21.
885.968
457.659
235.297

Subtract:

22.
912,836
611,746

23.
384.030
196.740

24.
8021.34
968.79

Find the answers:

25. $3\frac{7}{8} + 1\frac{3}{4}$
26. $3\frac{7}{8} - 1\frac{3}{4}$
27. $3\frac{7}{8} \times 1\frac{3}{4}$
28. $3\frac{7}{8} \div 1\frac{3}{4}$
29. $1\frac{3}{4} \times 3\frac{7}{8}$
30. $1\frac{3}{4} \div 3\frac{7}{8}$

31. The figures in the product of 247.68 and 0.441 are, from left to right, 1, 0, 9, 2, 2, 6, 8, and 8. Write the product with the decimal point correctly placed.

32. From Ex. 31, write the quotient of 1092.2688 divided by 44.1; of 109.22688 divided by 4.41.

Review of Banking Terms

Write the numbers 1 to 9 on your paper, and after each write the letter indicating the expression in the parentheses that you think is best for completing the statement:

1. The amount that a man has in his bank account is called his (*a.* balance. *b.* discount. *c.* statement. *d.* indorsement).

2. A check is a written order to a bank to (*a.* charge interest. *b.* collect money. *c.* pay dividends. *d.* pay money).

3. The person to whom a check is made payable is called the (*a.* receiving teller. *b.* cashier. *c.* payee. *d.* maker).

4. The maker of a check is the person who (*a.* indorses it. *b.* cashes it. *c.* signs it. *d.* cancels it).

5. In order to collect the money for a check, the one to whom it is payable must (*a.* sign his name across the back. *b.* return his bank book. *c.* make out a deposit slip. *d.* deposit some security with the bank).

6. After a check is paid by the bank upon which it is drawn, it is returned to the (*a.* receiving teller. *b.* indorser. *c.* maker. *d.* post office).

7. A canceled (paid) check returned by a bank serves as a (*a.* bill. *b.* promissory note. *c.* deposit slip. *d.* receipt).

8. Before writing a check, you should be sure that you have in your account enough money to (*a.* pay the interest. *b.* pay the check. *c.* discount the note. *d.* make a deposit).

9. If, by mistake, you should write a check for more money than you have in the bank, the bank would notify you that you had (*a.* deposited too much. *b.* disregarded the interest. *c.* overdrawn your account. *d.* increased your balance).

SUPPOSE that Mr. Clark **in Denver** owes $475 to a manufacturer **in Chicago.** It would cost too much for Mr. Clark to carry the money to Chicago himself or send someone with it, and it would be too risky to put the money in an ordinary letter and send it by mail.

There are several ways in which Mr. Clark could safely send the money, as follows:

1. He could send his **personal check** for $475 drawn on the Denver bank at which he has an account. The manufacturer would deposit the check at a bank in Chicago. The check would be returned to Mr. Clark's bank in Denver for payment.

2. He could send it by **postal money order** by buying four orders for $100 each and one for $75 at a post office in Denver. Each order for $100 would cost 22¢, and the one for $75 would cost 20¢.

3. He could send $475 **in cash by registered letter.** The charge for registering the letter so as to receive $475 in case of loss would be 60¢.

4. He could use **express money orders.** This is practically the same as the second plan, except that the money orders are bought at an express office. The cost would be $1.16.

5. He could send the money **"by telegraph"** by taking it to a telegraph office. The telegraph company would send a telegram to Chicago directing the telegraph office there to pay the manufacturer $475. This method would cost $2.82.

The first two methods are the most common ways for individuals. The third way is not so satisfactory because there would be no way of tracing the payment if it should be lost or mislaid after being received at the manufacturer's office.

1. Suppose that you have to send \$475 to someone who lives at a distance and that the cost of sending the money is the same as given on the opposite page. If you cannot send a personal check because you have no bank account, which one of the other four methods would you use? Give reasons.

2. Banks sometimes make a charge for collecting checks that are drawn on banks in distant places. When the rate charged is 0.1% of the face of the check, how much will a bank charge for collecting a check for \$250?

3. Banks sometimes have to send money to other banks, and they often do so by express. At 2¢ per ounce, how much, including \$2.50 extra for insurance against loss, will it cost to send a package of currency that weighs $8\frac{1}{2}$ lb.?

4. Postal money orders for amounts from \$20.01 to \$40.00 cost 15¢ each, and 18¢ each from \$40.01 to \$60.00. If you wish to buy four orders for \$25.50, \$38.75, \$52.60, and \$41.25 respectively, how much, including the cost of the orders, should you take with you to the post office?

5. Postal money orders are not issued in amounts larger than \$100, and an order for \$100 costs 22¢. How many orders will you have to buy to send \$1650 this way? How much (see Ex. 4 for the cost of an order for \$50) will it cost?

6. When the rate for sending money to a certain place by telegraph is 85¢ for the first \$100, and 25¢ for each additional \$100, or fraction thereof, up to \$3000, how much will it cost to send \$1875 by telegraph?

7. The fee for registering a letter so as to receive up to \$50 in case of loss is 15¢. If you send \$20 in cash by registered letter, what per cent of the \$20 will you be paying for insuring the money against loss?

MR. HART of Atlanta is ordering some goods from the West Manufacturing Co. of Chicago, and has to send the money with the order. He secures from his own bank the **draft on Chicago** shown below, and sends this with the order.

No. 8694

SIXTH NATIONAL BANK

ATLANTA, GA., Jan. 17, 19—

PAY TO THE ORDER OF West Manufacturing Co. $142.50

One hundred forty-two and 50/100 DOLLARS

TO THE ELEVATED NATIONAL BANK CHICAGO, ILL.

Irving L. Ross CASHIER

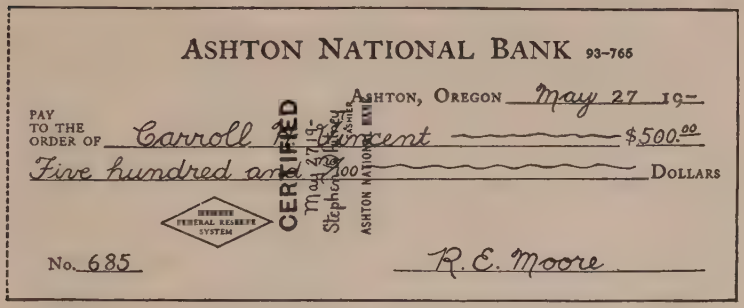
Although called a "draft," this is simply a check drawn by the Atlanta bank against its account in a Chicago bank. Being the check of a bank, it will be accepted without question.

1. When the Atlanta bank issued the draft shown above, it charged the amount to Mr. Hart's account. His bank balance was $685.07. How much was it after the draft was issued?

2. Mr. Bond asked his bank for a draft on New York to pay for some goods that he was ordering. The order amounted to $1268.50 at list prices, and Mr. Bond was to receive a trade discount of 30% and an additional 2% for cash. For how much was the draft made out?

3. While he was in Washington, Mr. Wade of New York wanted to send a draft to Chicago for $850. Since he had no account there, the Washington bank charged him 0.1% of the face for issuing the draft. How much did the bank charge?

THE check below shows another way of making sure that the maker of a check (Mr. Moore in this case) has enough money in his bank account to pay the check when presented.


ASHTON NATIONAL BANK 93-765

ASHTON, OREGON May 27 19--

PAY TO THE ORDER OF Carroll Vincent $500.00

Five hundred and 00/100 DOLLARS

CERTIFIED May 27 19-- Stephen Cashier ASHTON NATIONAL BANK

MEMBER FEDERAL RESERVE SYSTEM

No. 685 R. E. Moore

This is what is known as a **certified check.** Before Mr. Moore sends or gives the check to Mr. Vincent, he takes it to his bank and has it stamped across the face as shown. This means that **the bank guarantees the payment of the check,** and the money is taken from Mr. Moore's account and held in a special account until the check is presented.

1. Before Mr. Moore had the above check certified, his bank balance was $807.62. How much was it afterward?

2. Certified checks are often used in making payments in business transactions, such as buying a house. Mr. Cole is buying a house for $9600 and agrees to pay 30% down by certified check at the time the deed is signed. For how much should the check be drawn?

3. Mr. Rice had $608.37 in the bank. He had two checks certified, one for $124.55 and the other for $145.10. How much was his bank balance after this was done?

MANY people in this country send money to relatives in Europe and other parts of the world, and American merchants often have to pay in foreign money for goods that they have purchased abroad.

The following table shows the **principal money units of several foreign countries** and their normal values in our money:

Country	Name of Unit	Value
Great Britain	Pound (£)	$4.86\frac{5}{8}$
France	Franc (fr.)	3.92¢
Italy	Lira (l.)	5.26¢
Germany	Reichsmark (Rm.)	23.8¢
Norway	Krone (Kr.)	26.8¢
Sweden	Krona (Kr.)	26.8¢
Spain	Peseta (Pt.)	19.3¢
Greece	Drachma (Dr.)	1.3¢
Poland	Zloty (Zl.)	11.22¢
Switzerland	Franc (fr.)	19.3¢
Japan	Yen (Y.)	49.8¢
Mexico	Peso (P.)	49.8¢

The values in the above table are gold values, which are called **par values.** The rates at which you can buy drafts (checks) made out in foreign money frequently vary from day to day, depending upon business conditions. These rates are called the **rates of exchange.**

Rates of exchange are sometimes **below par** and sometimes **above par.** For example, when you can buy English pounds at $\$4.84\frac{1}{2}$, exchange is "below par." At this rate, a draft for £10 would cost $10 \times \$4.845$, or \$48.45. At \$4.88, exchange is "above par," and the draft for £10 would cost \$48.80.

Newspapers usually give the rates of exchange at which foreign drafts can be bought from day to day.

1. Edward Martin is sending £5 to his mother in Liverpool, England. If the rate of exchange on the day he sends it is $\$4.84\frac{11}{16}$, how much is the rate above or below par? How much will the draft (check) cost?

In Ex. 1, find the cost of the draft when the rate is

2. $\$4.86$ **3.** $\$4.87\frac{1}{8}$ **4.** $\$4.84$ **5.** $\$4.85\frac{1}{4}$ **6.** $\$4.86\frac{5}{8}$

7. A department store has to send to England a draft for £480 to pay for some linen that the store bought. If the rate of exchange is $\$4.85\frac{5}{8}$, how much will the draft cost?

8. Louis Borel is sending 125 fr. to his sister in Paris. If the rate of exchange is $3.90\frac{5}{8}¢$, how much is this above or below par? What will the draft cost?

In Ex. 8, find the cost when the amount sent is

9. 300 fr. **10.** 275 fr. **11.** 1200 fr. **12.** 1850 fr.

13. Tony Ricoro is sending 500 lire (lē-rā, plural of lira) to a relative in Venice. If the rate of exchange is $5.22\frac{13}{16}¢$, how much will the draft cost?

In Ex. 13, find the cost of the draft when the rate is

14. $5.24¢$ **15.** $5.23\frac{1}{2}¢$ **16.** $5.24\frac{3}{8}¢$ **17.** $5.27¢$

18. A merchant has to send to Berlin a draft for 750 Rm. to pay for some goods that he bought. If the rate of exchange is $23.82\frac{1}{2}¢$, how much will the draft cost?

In Ex. 18, find the cost when the amount sent is

19. 300 Rm. **20.** 275 Rm. **21.** 1500 Rm. **22.** 3600 Rm.

23. Ole Jenson is buying a draft on Oslo, Norway, for 80 Kr. At a rate of $26.65¢$, how much will it cost?

Letter of Credit

WHEN Mr. Dale planned a trip around the world, he knew that he would need to obtain money in each country that he was going to visit. So before he started, he went to his bank and bought a **letter of credit** for $10,000. By means of this letter, he was able to get money at leading banks in various cities of the world, the total amount not to exceed $10,000. As each payment was made to him, the amount paid was recorded on the letter.

1. In Madrid, Mr. Dale got $250 worth of Spanish money on his letter of credit. The rate that day was 5.18 pesetas to the dollar. How many pesetas did he get?

2. In Athens, he drew $75 worth of Greek money. At 76.9 drachmas to the dollar, how many drachmas did he get?

3. While he was in Japan, he drew $300 on his letter of credit. At 2.02 yen to the dollar, how many yen did he get?

4. In Australia, where he spent considerable time, he drew $1455. At $4.85 to the pound, how many pounds did he get?

5. When a bank charges $\frac{3}{4}\%$ for issuing a letter of credit for $2500, how much is the charge for this service?

6. At $\frac{1}{2}\%$, how much will a bank charge for issuing a letter of credit for $12,500?

7. When Mrs. Snow went abroad, she carried **travelers' checks**, which she bought at her bank. She had 5 checks for $100 each, 10 for $50 each, and 25 for $20 each. How much money did she carry in this form?

8. In Ex. 7, the bank charged her $11.25 for issuing the checks. What per cent of the face value was charged?

1. At 20¢ for a postal money order for $75, what per cent of the face of the order does the government charge?

2. When the rate of exchange on London is $4.84\frac{1}{4}$, how much will a draft on London for £500 cost?

3. A store sent one draft to England for £120 to pay for goods, and another to France for 3600 fr. The rate on the English draft was $4.85\frac{1}{8}$, and the rate on the French draft was $3.91\frac{1}{2}$¢. If the store's bank balance was $12,682.77 before the drafts were made, what was it afterward?

4. When it costs $2.35 to telegraph $750 from Cleveland to Boston, what per cent of the amount sent does the telegraph company charge for this service?

5. By returning checks by air mail instead of regular mail, banks often save one or two days' interest. At 6%, how much is the interest for 1 da. on $120,000?

SPECIAL TIMED PRACTICE

Time: 10 min.

1.	2.	3.	4.
79,786	8925.58	334.960	991.37
77,959	7148.98	654.666	231.34
48,767	578.06	370.089	522.45
90,095	+ 5698.79	+ 832.348	212.45
+ 34,565			+ 763.47

5.	6.	7.	8.	9.
$17\frac{2}{3}$	$18\frac{1}{5}$	$24\frac{3}{8}$	$25\frac{4}{5}$	$14\frac{1}{8}$
$- 6\frac{1}{2}$	$- 5\frac{3}{4}$	$- 1\frac{1}{3}$	$- 6\frac{1}{10}$	$- 9\frac{3}{4}$

10. Using cancellation, find the product of $2\frac{3}{4} \times 8 \times 7\frac{1}{2}$.

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. Mr. Wills sold a piece of land for which he paid \$1250 at a profit of 15% of the cost. What was the selling price?

2. At 6% of the cost, how much will an architect receive for making the plans for a house that is to cost \$14,500?

3. At 66¢ per \$100 for a 3-year policy, how much does it cost per year to insure a house against fire for \$8500?

4. A grocer paid $4\frac{1}{2}$¢ a pound for potatoes. If he sells them at $33\frac{1}{3}$% above cost, what is the selling price per pound?

5. On an automobile map drawn to the scale of 1 in. to 8 mi., what distance on the map represents 68 mi.?

6. How many pounds of butter fat can be obtained from a shipment of 1650 lb. of milk which tests 3.8% fat?

7. In shipping 330 bu. of potatoes, how many barrels, each holding $2\frac{3}{4}$ bu., will be needed?

8. Mr. Gore still owes \$6500 on his house. At $5\frac{3}{4}$%, how much interest does he pay a year on this amount?

9. Mr. Todd's car cost \$2450 when new. It is now worth 28% less than this. How much is it worth now?

10. To make 1200 lb. of a bronze that is to contain $84\frac{1}{2}$% copper, by weight, and the rest tin, how much of each of these metals should be used?

Investing Money

YOU have already learned that **thrifty people make their savings earn an income** by investing them in some way. Some people put their savings into banks, others buy land and houses, and others **invest their money in corporations** which are organized to carry on various kinds of business.

1. Mrs. Wade has $12,000 to invest. By dividing it up and depositing it in several savings banks, she can make it earn $4\frac{1}{2}\%$ a year. How much income would she get every 6 mo.?

2. Mrs. Wade's banker told her about a well-managed manufacturing corporation which pays $5\frac{1}{2}\%$ a year to people who invest money in the business. How much income would Mrs. Wade get every 6 mo. if she invests her $12,000 this way?

3. **Not all corporations are safe investments.** Some business concerns are not well managed, and **some investments offered by dishonest people are absolutely worthless.** Often such investments promise a very high rate of income. When the Wildcat Mining Co. is promising 18% a year, how much yearly income is it promising to a person who will invest $12,000?

Find the amount of yearly income from these investments:

	Amount Invested	Yearly Rate	Yearly Income
4.	$5000	$4\frac{1}{4}\%$	
5.	$7500	$5\frac{1}{2}\%$	
6.	$8800	$6\frac{1}{4}\%$	
7.	$9600	$7\frac{1}{2}\%$	

	Amount Invested	Yearly Rate	Yearly Income
8.	$12,500	$5\frac{1}{2}\%$	
9.	$15,000	$4\frac{3}{4}\%$	
10.	$26,500	8%	
11.	$35,000	$6\frac{3}{4}\%$	

INCORPORATED UNDER THE LAWS OF
THE STATE OF ILLINOIS

No. 4562 75 SHARES

Northern Manufacturing Company

CAPITAL STOCK $500,000

FULL PAID AND NON-ASSESSABLE

This Certifies that E. L. Thomas

is the owner of Seventy-five Shares of the Capital Stock of the

Northern Manufacturing Company

transferable only on the Books of the Corporation in person or by Attorney upon surrender of this Certificate.

In Witness Whereof, the duly authorized officers of this Corporation have hereunto subscribed their names and caused the corporate Seal to be hereto affixed this fifth day of August A.D. 19—

T. D. Holmes, TREASURER — F. W. Norris, PRESIDENT

NORTHERN MANUFACTURING COMPANY

SHARES $100 EACH

AS YOU learned last year, a corporation needs a certain amount of money, or **capital** as it is called, to carry on its business. If, for example, it needs $100,000, it will issue $100,000 worth of **stock** (sometimes called **capital stock**), divided into units called **shares**.

The people who buy these shares are called the **stockholders** of the corporation, and each receives a **stock certificate**, which is in some such form as the one pictured above, to show how many shares of stock he has bought.

The value at which a share of stock is issued is called its **par value**, and is often $100. Some corporations issue stock with par values of $50, $25, $10, $5, or other amounts. Stock is sometimes issued without any stated par value, a practice that is rapidly growing.

ON THIS page, you are to select from among the four computations in each set of parentheses **the one that should be used in solving the example. You need not find the answers.**

Write the numbers 1 to 11 on your paper, and after each write the letter that shows the computation you select:

1. 15 is what per cent of 45? (*a.* $45 \div 15$. *b.* 0.15×45. *c.* $\frac{1}{15} \times 45$. *d.* $15 \div 45$.)

2. $12\frac{1}{2}$ is 5% of what number? (*a.* $\frac{1}{20} \times \frac{1}{8}$. *b.* $12.5 \div 0.05$. *c.* $5 \div 12\frac{1}{2}$. *d.* $\frac{1}{8} \times 5$.)

3. How much is $16\frac{2}{3}\%$ of 720? (*a.* $\frac{1}{6} \times 720$. *b.* $720 \div 0.16\frac{2}{3}$. *c.* $16\frac{2}{3} \div 720$. *d.* $720 \div \frac{1}{6}$.)

4. How much is 125% of 125? (*a.* $125 \div 125$. *b.* $1\frac{1}{4} \times 1\frac{1}{4}$. *c.* $125 \div 1.25$. *d.* $1\frac{1}{4} \times 125$.)

5. 150 is 125% of what number? (*a.* 150×1.25. *b.* $150 \div 125$. *c.* $150 \div 1\frac{1}{4}$. *d.* $\frac{5}{4} \times 150$.)

6. 195 is what per cent of 150? (*a.* $195 \div 150$. *b.* $1\frac{1}{2} \times 195$. *c.* $195 \div 1\frac{1}{2}$. *d.* $150 \div 195$.)

7. 106 is 20% more than what number? (*a.* $\frac{1}{5} \times 106$. *b.* $106 \div 0.80$. *c.* $1.20 \div 106$. *d.* $106 \div 1.20$.)

8. 30 is 40% less than what number? (*a.* $\frac{1}{40} \times 30$. *b.* $30 \div 0.60$. *c.* $0.40 \div 30$. *d.* $30 - \frac{30}{40}$.)

9. What number is 30% less than 96? (*a.* 0.70×96. *b.* $96 \div 0.30$. *c.* $30 \div 96$. *d.* $96 - 0.30$.)

10. What number is 30% more than 96? (*a.* $96 \div 1.30$. *b.* $96 \div 0.30$. *c.* 1.30×96. *d.* $96 \div 0.70$.)

11. How much is $12\frac{1}{2}\%$ of 75%? (*a.* $\frac{1}{8} \times 75\%$. *b.* $\frac{1}{8} \div \frac{3}{4}$. *c.* $0.12\frac{1}{2} \div 0.75$. *d.* $0.75 \times \frac{1}{800}$.)

THE stockholders of a corporation are the **owners of the business**, and they elect a **board of directors** to manage it. The directors choose the **officers** of the corporation, which are usually a president, vice president, secretary, and treasurer, to have direct charge of the work.

Each stockholder, as a part owner of the business, receives **a share of any profits** that are made. Such profits are distributed to the stockholders in the form of **dividends**, which are generally paid as a certain **per cent of the par value** or as a certain **amount per share.**

In the problems in this book, take the par value of a share of stock as $100, unless it is specifically stated otherwise.

1. A group of 5 business men are organizing a company to manufacture a new style of traffic light. They will need $150,000 as capital to start work. How many shares (par value, $100) will the company need to issue?

2. In Ex. 1, each of the 5 men bought 160 shares at the par value. How much did each man invest?

3. In Ex. 2, what per cent of the stock remained to be sold?

4. A company with a capital of $250,000 issued 5000 shares of stock. What was the par value of each share?

5. A company capitalized at $350,000 issued $100,000 worth of new stock. How many shares have been issued in all?

6. A corporation paid a dividend of 6% on its stock one year. How much did the holder of 20 shares receive that year?

7. The next year the corporation in Ex. 6 did not make so much profit, and so the dividend rate was cut to $4\frac{1}{2}\%$. How much less did the holder of the 20 shares receive?

8. A company declared a quarterly (3 mo.) dividend of \$1.25 per share. How much did the owner of 40 shares receive? What was the dividend rate (per cent) for the quarter?

9. A corporation capitalized at \$2,500,000 declared two semiannual (6 mo.) dividends last year, each of $2\frac{3}{4}\%$. How much money did the stockholders receive during the year?

10. A small manufacturing company capitalized at \$250,000 has \$6250 available to distribute among its stockholders as a semiannual dividend. What per cent of dividend can the directors declare on the company's stock?

11. Most corporations do not distribute their entire profits as dividends, but transfer a certain amount to a **surplus account** to provide for emergencies. A company capitalized at \$500,000 earned \$11,253.64 above expenses in the last 3 mo. If the directors wish to carry about \$2500 to surplus, what quarterly dividend rate (per cent) can they declare?

Find the numbers that belong in the blank spaces:

	Total Capital Stock	Amount Distributed as Dividends	Dividend Rate	Shares Owned by Mr. A	Amount of Dividends Received
12.	\$50,000	\$1250	_____%	10	\$_____
13.	\$400,000	\$18,000	_____%	25	\$_____
14.	\$500,000	\$_____	$2\frac{1}{2}\%$	40	\$_____
15.	\$800,000	\$22,000	_____%	_____	\$27.50
16.	\$_____	\$30,000	3%	120	\$_____
17.	\$2,500,000	\$_____	$4\frac{1}{2}\%$	_____	\$450
18.	\$_____	\$200,000	4%	350	\$_____

Courtesy of the Boston Stock Exchange

STOCKS are bought and sold at **stock exchanges**, which are auction rooms located in the principal cities like New York, Chicago, and Boston. The actual sales are made through **brokers** who are members of the exchanges.

The **market price** of a share of stock, which is the price at which it can be bought or sold, varies greatly. If the corporation is paying big dividends, people will be anxious to buy the stock, and the price will probably be **above par**. For example, a stock of par value \$100 that is selling at $162\frac{3}{8}$, which means \$162.37$\frac{1}{2}$ a share, is \$62.37$\frac{1}{2}$ above par.

If the dividend rate is small, or the company fails to pay dividends, the stock may drop **below par**; for example, at $87\frac{1}{2}$ a stock is \$12.50 below a par value of \$100.

Records of stock-exchange transactions with prices (called **stock quotations**) are published in the newspapers.

WHEN a stock broker buys or sells stock, he charges **brokerage**, which is simply another name for **commission**, for his services. You need not learn the brokerage rates given in the table below; simply refer to them when necessary.

Market Price per Share	Rate per 100 Shares
For stocks selling between 10 and 125 . . .	\$15.00
For stocks selling at 125 and over	20.00
Minimum charge for any transaction . . .	3.00

For less than 100 shares, the rates are proportionally the same. For example, on 30 shares at $114\frac{1}{4}$, the brokerage would be $\frac{30}{100} \times \$15$, or $0.30 \times \$15$, which is \$4.50. On less than 20 shares of this stock, the minimum of \$3 would be charged.

Study these two examples and be sure you understand them.

(1) The investor buys		(2) The investor sells	
\$118.25	← Price $\left(118\frac{1}{4}\right)$	\$138.37$\frac{1}{2}$	← Price $\left(138\frac{3}{8}\right)$
× 400	← No. of shares	× 50	← No. of shares
\$47,300.00	← Market cost	\$6918.75	← Amt. of sale
+ 60.00	← Brokerage	− 10.00	← Brokerage
\$47,360.00	← Total cost	\$6908.75	← Proceeds

In (1) the market price is $118\frac{1}{4}$, and so the brokerage is $4 \times \$15$, or \$60. In (2) the market price is over 125, and so the brokerage is $\frac{1}{2} \times \$20$, or \$10.

When an investor buys stock, the broker adds his commission to the cost of the stock at the market price.

When an investor sells stock, the broker deducts his commission and pays the proceeds (balance) to the investor.

In these problems remember to add or subtract the brokerage (page 351) according as the stock is bought or sold.

1. Mr. Green bought 200 shares of stock at $108\frac{1}{4}$. How much did he pay for it in all?

2. Mr. Ray sold 250 shares at $134\frac{7}{8}$. How much did he receive from the sale?

3. Mrs. Hoyt bought 3 shares of stock at $116\frac{3}{4}$ as an investment. Noticing that in this case she must pay the minimum brokerage charge, find the amount that she invested.

4. Some corporations issue **preferred stock** on which **the dividend rate is fixed**, often at 6% or 7%. How much will it cost to buy 40 shares of 6% preferred stock at $102\frac{1}{8}$? How much will be the income per year from these shares?

5. **Dividends on preferred stock** must be paid **before the dividends on common stock**, but when a company is making large profits, the common-stock rate is often higher. How much will 40 shares of common stock cost at $130\frac{1}{2}$? At $8\frac{1}{2}$%, how much will be the income per year from these shares?

Find the amounts that belong in the blank columns:

	Shares Bought	Market Price	Total Cost
6.	200	180	
7.	250	$106\frac{1}{8}$	
8.	80	$132\frac{5}{8}$	
9.	1000	$67\frac{7}{8}$	

	Shares Sold	Market Price	Received from Sale
10.	600	$140\frac{1}{2}$	
11.	5	$218\frac{1}{2}$	
12.	40	$129\frac{3}{4}$	
13.	1200	$80\frac{5}{8}$	

INVESTMENTS in stocks not only bring an income in the form of dividends, but also, as in buying and selling good real estate, **a profit can sometimes be made.**

For example, suppose that Mr. Cole buys 20 shares of stock at 187 and sells it later at $192\frac{1}{4}$. How much is his profit?

He buys		He sells	His profit
\$187.00	←Price→	\$192.25	\$3841 ←Proceeds
× 20	←Number→	× 20	− 3744 ←Total cost
\$3740.00		\$3845.00	\$97 ←Profit
+ 4.00	←Brokerage→	− 4.00	
\$3744.00	←Total cost	\$3841.00	←Proceeds

It is not always possible to make a profit. Stocks can go down in price instead of up, and there may be a loss.

Find the amount of profit or loss in each of these cases:

	Name of Stock	No. of Shares	Bought at	Sold at
1.	American Bank Note Co.	100	$60\frac{1}{2}$	$62\frac{1}{2}$
2.	Baltimore & Ohio R.R.	40	$113\frac{1}{4}$	$105\frac{1}{2}$
3.	General Electric Co.	60	$120\frac{1}{2}$	$105\frac{1}{4}$
4.	Pennsylvania R.R.	120	$87\frac{5}{8}$	$107\frac{1}{2}$
5.	United Fruit Co.	80	$118\frac{1}{2}$	$126\frac{7}{8}$
6.	United States Steel Co.	150	$145\frac{5}{8}$	$157\frac{7}{8}$
7.	Pullman Co.	250	$83\frac{7}{8}$	$86\frac{7}{8}$
8.	New York Central R.R.	300	$173\frac{1}{2}$	$165\frac{1}{4}$

1. The capital stock of a company which is capitalized at \$2,500,000 consists of \$250,000 worth of 6% preferred stock, and the rest is common stock. How many shares of each kind are there?

2. In Ex. 1, how much does the owner of 150 shares of the preferred stock receive per year? When the common stock pays quarterly dividends of \$1.75 per share, how much does the owner of 150 shares receive per year?

3. Mr. James bought 200 shares of Radio Corporation stock at 74. Some time later he sold the stock at $82\frac{7}{8}$. Did he gain or lose on the deal, and how much?

4. Mrs. Whitehouse bought 75 shares of Bethlehem Steel Co. stock at $122\frac{1}{4}$ and sold it later at $126\frac{1}{8}$. Did she gain or lose on the deal, and how much?

See how quickly you can find the answers:

5. $112\frac{1}{2}$	6. $68\frac{1}{4}$	7. $87\frac{3}{8}$	8. $146\frac{1}{2}$	9. $106\frac{1}{4}$
$\times 25$	$-45\frac{7}{8}$	$\times 200$	$-138\frac{5}{8}$	$\times 50$
10. $237\frac{1}{8}$	11. $64\frac{1}{8}$	12. $190\frac{1}{4}$	13. $70\frac{7}{8}$	14. $257\frac{1}{8}$
$-189\frac{5}{8}$	$\times 150$	$-184\frac{3}{4}$	$\times 120$	$-199\frac{7}{8}$

Find these per cents:

15. 6% of \$1200
16. $5\frac{1}{2}$% of \$3200
17. $1\frac{1}{2}$% of \$8000
18. $2\frac{3}{4}$% of \$6400
19. $3\frac{1}{2}$% of \$7200
20. 4% of \$24,000
21. $5\frac{3}{8}$% of \$38,200
22. $7\frac{1}{2}$% of \$48,000
23. $1\frac{7}{8}$% of \$20,000
24. $3\frac{3}{4}$% of \$42,000

WHEN corporations wish to borrow large sums of money for new buildings or machinery, or for extending their business in other ways, they usually do so by issuing and selling bonds which bear interest at some specified rate.

A bond, like a note, is simply a promise to pay money, and usually runs for a number of years. The corporation's property is often pledged as security for the payment of the bonds and interest. Such bonds are called **mortgage bonds.**

Bond interest is usually paid every 6 mo. Like dividends on stock, the interest is always computed on the **face value,** which is the amount for which the bond is issued.

Bonds pay a fixed rate of interest. Stocks (common) pay dividends that depend upon the amount of profit made.

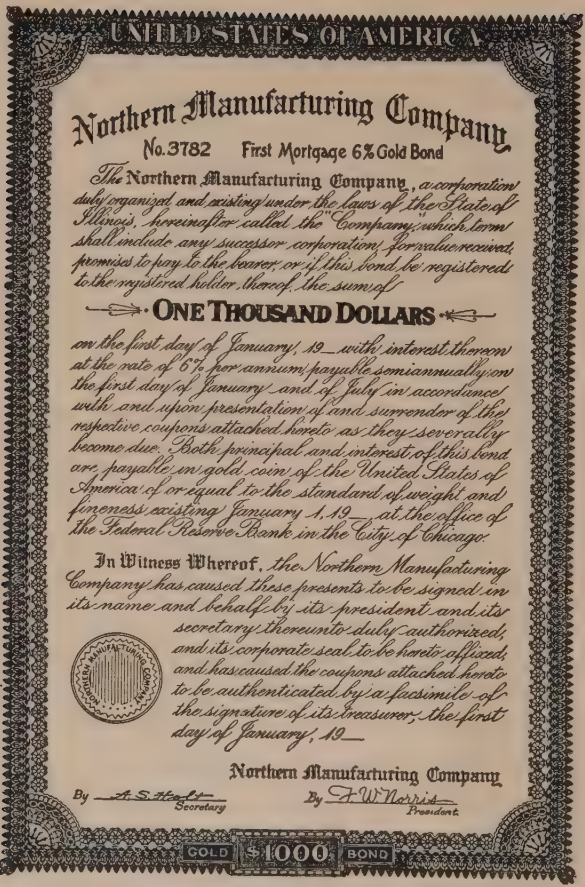
1. A corporation wishes to borrow $250,000 for 20 yr. If it does so by issuing bonds, each with a face value of $1000, how many bonds should the company have printed?

2. In Ex. 1, the bonds are to bear interest at 6%, payable semiannually (every 6 mo.). How much will the company have to set aside every 6 mo. to pay the bond interest?

3. A 6% bond for $1000 is issued for a period of 20 yr. If the bond is allowed to run the full time, what will be the total amount of interest that the company will pay on it?

4. Mrs. Davis owns some $5\frac{1}{2}\%$ bonds with a total face value of $6000 and some $4\frac{3}{4}\%$ bonds with a total face value of $3500. How much interest does she receive every 6 mo.?

5. Mr. Wade bought 7 bonds, each with a face value of $500. If the bonds bear interest at 5%, payable every 6 mo., how much does Mr. Wade receive on each interest day?



UNITED STATES OF AMERICA

Northern Manufacturing Company

No. 3782 First Mortgage 6% Gold Bond

The Northern Manufacturing Company, a corporation duly organized and existing under the laws of the State of Illinois, hereinafter called the "Company," which term shall include any successor corporation, for value received, promises to pay to the bearer, or if this bond be registered, to the registered holder thereof, the sum of

ONE THOUSAND DOLLARS

on the first day of January, 19— with interest thereon at the rate of 6% per annum payable semiannually on the first day of January and of July in accordance with and upon presentation of and surrender of the respective coupons attached hereto as they severally become due. Both principal and interest of this bond are payable in gold coin of the United States of America of or equal to the standard of weight and fineness existing January 1, 19— at the office of the Federal Reserve Bank in the City of Chicago.

In Witness Whereof, the Northern Manufacturing Company has caused these presents to be signed in its name and behalf by its president and its secretary thereunto duly authorized, and its corporate seal to be hereto affixed, and has caused the coupons attached hereto to be authenticated by a facsimile of the signature of its treasurer, the first day of January, 19—

Northern Manufacturing Company

By A. S. Hoyt, Secretary

By F. W. Norris, President

GOLD $1000 BOND

Bond

Coupons

BONDS are often issued with small attached certificates, called **coupons**, one for each interest payment. When the interest is due, the proper coupon is cut off and presented for payment. Banks accept and collect coupons for depositors.

BONDS are bought and sold by brokers at stock exchanges in much the same way as stocks. **The usual commission on such transactions is $2 for each $1000 of face value.**

The market prices of bonds, like stock, may be **at par** (face value), **above par**, or **below par**. A price of $94\frac{1}{2}$ means \$94.50 per \$100 of face value, or \$945 for a bond for \$1000.

1. Mr. Green bought 5 bonds, each of face value \$1000, at $98\frac{1}{2}$. Including the commission, how much did they cost him?

2. In Ex. 1, the bonds bear interest at $5\frac{1}{2}\%$. How much income does Mr. Green receive per year from the bonds?

3. Mrs. Hackett bought some 6% bonds with a face value of \$6000 at $101\frac{1}{2}$ and some $5\frac{1}{2}\%$ bonds with a face value of \$8000 at $97\frac{7}{8}$. Including the commission, how much did they cost?

4. Mr. Cole sold 9 bonds, each with a face value of \$1000, at $94\frac{3}{4}$. After the broker's commission was deducted, how much did Mr. Cole receive from the sale?

Including the usual commission, find in each of these cases the amounts that belong in the blank columns, as in Ex. 5:

	No. of Bonds	Face of Each Bond	Market Price	Total Cost	Rate of Interest	Yearly Income
5.	7	\$1000	$102\frac{1}{4}$	\$7171.50	6%	\$420
6.	8	\$1000	$87\frac{1}{2}$		5%	
7.	12	\$500	$96\frac{3}{4}$		$5\frac{1}{2}\%$	
8.	18	\$1000	$103\frac{1}{8}$		$6\frac{1}{2}\%$	
9.	25	\$1000	$102\frac{5}{8}$		7%	
10.	75	\$1000	$99\frac{3}{8}$		$5\frac{3}{4}\%$	

OUR various governments, national, state, county, city, town, and village, often borrow money on bonds. Foreign governments also issue bonds which are sold in this country.

The bonds of a national government are called **government bonds**, and those of a state are called **state bonds**. Bonds issued by counties, cities, towns, and villages are generally classed together as **municipal bonds**.

1. When the government of the United States borrows money, investors are certain that both bonds and interest will be paid. The interest rates are therefore low. Mr. Rice bought $3\frac{3}{8}\%$ U. S. Treasury bonds with a face value of \$14,000. How much income does he receive every 6 mo.?

2. The credit of some small foreign governments is not so good as that of the United States. The interest rates are therefore higher. How much will an investor receive per year from 8% foreign government bonds with a face value of \$9000?

Find in each case the amount that belongs in the last column:

	Type of Bond	Amount of Bond Issue	Rate of Interest	Total Yearly Interest
3.	County	\$200,000	$4\frac{1}{2}\%$	
4.	City	\$500,000	$4\frac{3}{4}\%$	
5.	State	\$2,000,000	4%	
6.	Village	\$40,000	5%	
7.	United States .	\$500,000,000	$3\frac{3}{8}\%$	
8.	Foreign (good) .	\$50,000,000	5%	
9.	Foreign (poor) .	\$12,000,000	8%	

10. Give any reasons that you can for the different rates of bond interest in Exs. 3 to 9 on the opposite page.

Taking the face value of each bond as $1000 and adding brokerage, find the amounts that belong in the blank columns:

	Government Bonds of	Number Bought	Market Price	Total Cost	Rate of Interest	Yearly Income
11.	United States .	8	$98\frac{1}{2}$		$3\frac{3}{8}\%$	
12.	Brazil	6	96		$6\frac{1}{2}\%$	
13.	Canada	15	$104\frac{1}{2}$		5%	
14.	France	10	$108\frac{1}{2}$		7%	
15.	Great Britain .	25	$104\frac{3}{4}$		$5\frac{1}{2}\%$	
16.	Italy	5	$97\frac{1}{2}$		7%	
17.	Japan	9	$92\frac{3}{4}$		4%	
18.	Sweden	20	$103\frac{5}{8}$		$5\frac{1}{2}\%$	

19. A city borrowed $500,000 and issued bonds bearing interest at $4\frac{3}{4}\%$. How much money did the city have to provide to pay the first year's interest on this bond issue?

20. In Ex. 19, the city paid off $\frac{1}{20}$ of the bonds at the end of the first year, the same amount at the end of the second, and so on for 20 yr. By how much was the interest charge in Ex. 19 reduced each year? How much should the city provide to pay the interest on the bonds the third year?

21. A city borrowed $150,000 by issuing 10-year 5% bonds, of which $\frac{1}{10}$ were to be paid off each year. Make a table showing the amount of the bonds outstanding and the yearly interest charge for each of the 10 yr.

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. Mr. Eliot's car runs 15.6 mi. on 1 gal. of gasoline. At 22¢ a gallon, how much will the gasoline cost for a trip of 85.8 mi.?

2. At a sale, Marian bought a 2-dollar fountain pen for $1.80. At what per cent off did she buy it?

3. If your school team wins 18 out of 30 games played, what is the ratio of games lost to games won?

4. Last week Walter sold 125 magazines at 5¢ each. At 40%, how much commission did he receive on his sales?

5. The Adams School yard is 40 rd. long and 20 rd. wide. The distance around the yard is what part of a mile?

6. Last summer Jane Starr earned $375. She saved 60% of this toward her college expenses. How much did she save?

7. A city borrowed $450,000 by issuing bonds. At $4\frac{3}{4}$%, how much was the first year's interest on the bonds?

8. It cost $3940 to ship 20,000 bu. of wheat from Duluth to Hamburg, Germany. What was the cost per bushel?

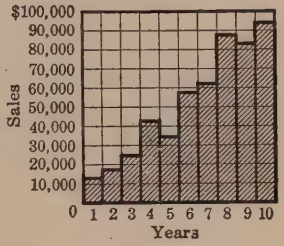
9. At $2\frac{1}{2}$¢ a pound, what is the cost of 1200 ft. of iron rods that weigh $2\frac{1}{8}$ lb. to the foot?

10. Lucy peeled 5 lb. of potatoes. The peeled potatoes weighed 4 lb. 4 oz. What per cent of the original weight of the potatoes was lost in peeling?

The Use of Graphs in Business

CORPORATIONS and other forms of business organizations make frequent use of graphs in studying facts about their own business or about business conditions in this or other countries.

This graph shows the yearly sales of a small manufacturing company for a period of 10 yr. When it was shown to the stockholders at their meeting, they could see at a glance how the business was progressing.



Paper ruled in squares, like those in the above graph, is called **squared paper**. If you do not have any, you can easily rule some with squares $\frac{1}{4}$ in. or $\frac{1}{8}$ in. on a side.

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1. In the above graph, about how much were the sales the first year? the second year? the tenth year?

2. In what years, as shown by the graph, was there a decrease in the sales as compared with the previous year?

3. Estimate from the graph the amount of sales that the company might reasonably expect the next (eleventh) year.

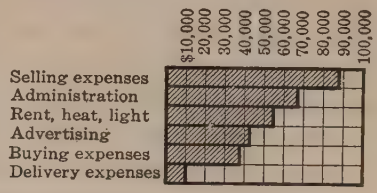
Draw bar graphs to represent these facts:

4. Yearly sales of a grocery store: \$26,000, \$42,000, \$57,000, \$46,000, \$61,000, \$66,000, \$70,000, \$74,000, \$78,000, \$82,000.

5. Yearly production of lumber in the United States, in billions of board feet: 36, 32, 35, 34, 27, 32, 37, 36, 38, 37.

6. Price per ton of pig iron for 10 yr.: \$15.80, \$23.90, \$43.60, \$36.70, \$31.10, \$44.40, \$25.30, \$27.60, \$29.00, \$23.30.

ONE of the big problems in running a store is to keep the overhead expenses as low as possible. The accompanying graph shows the amounts that were spent in a recent year for each of the several items that made up the total overhead expenses of a large department store. Such a graph would be useful in studying the problem of how to reduce the overhead expenses of the store.



In drawing graphs, use a sharp pencil and measure carefully so that your graph will tell a true story.

1. In the above graph, which item was the largest? the smallest? About how much was spent for these purposes?

2. If, in the above case, you had to decide how to reduce expenses, which item (or items) of expense would you try to reduce? Give reasons for your answer.

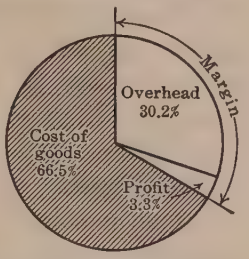
Draw bar graphs to represent these facts:

3. A year's expenses of a factory: wages, $101,250; raw materials, $67,500; factory operation, $27,000; selling expenses, $18,000; office expenses, $11,250.

4. Yearly world production of oil, in thousands of barrels: United States, 903.8; Russia, 72.4; Venezuela, 64.4; Mexico, 64.2; Persia, 36.8; Rumania, 26.1; Dutch East Indies, 21.4; other countries, 52.3.

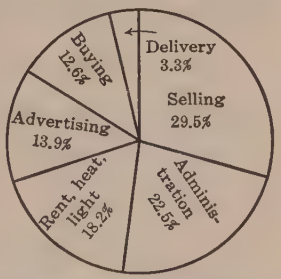
5. Expenditures of a state: highways, $4,575,000; education, $3,163,000; institutions, $2,500,000; legislature and governor, $1,663,000; state capitol, $850,000.

1. In representing statistics expressed as per cents, **the circular graph is often the most effective means of showing the relation of the various items to each other and to the whole.** This graph was used in studying the business of a small store. For each dollar taken in, how much was spent for goods? for overhead? How much was the profit on each dollar taken in?



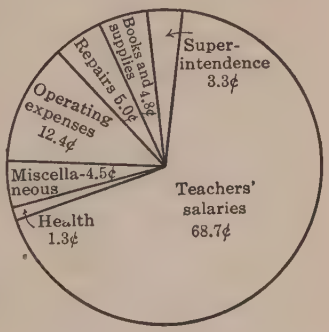
2. This graph relates to the same problem as the graph on the opposite page. It shows the various items computed as per cents of the total overhead expense. What would you need to know here in order to find the amounts spent for each purpose?

3. In Ex. 2, which graph tells the clearer story about the expenses? Would it be a good plan to use both graphs in studying the problem?

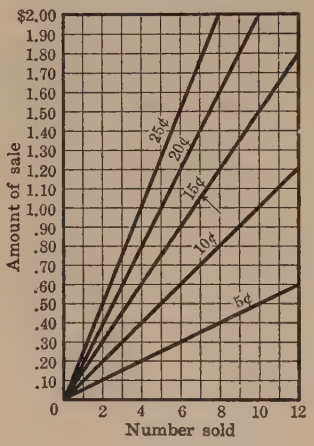


4. This graph shows how a town spent each dollar that it appropriated for running its schools one year. For what purpose did it spend the largest amount? the smallest amount?

5. In Ex. 4, if the total amount appropriated that year was $209,600, how much was spent for teachers' salaries? for operating expenses? for books and supplies? for repairs?



THE use of a graph as a means of saving labor in making computations can best be understood by taking a very simple case. For example, suppose that at one counter in a department store the prices of the articles run from 5¢ to 25¢ in multiples of 5¢. A graph like this one, but drawn to a larger scale, would be a convenient means of telling the amount of the sale for a given number of articles. Thus, when 7 articles are sold at 15¢ each, the amount is $1.05, as shown.



From the graph, find the amount of each of these sales:

1. 9 at 5¢ each.
2. 7 at 10¢ each.
3. 8 at 15¢ each.
4. 6 at 20¢ each.
5. 9 at 15¢ each.
6. 7 at 25¢ each.

7. Since 1 yd. = 3 ft., how many feet are there in 2 yd.? in 3 yd.? in 5 yd.? in 10 yd.? in 0 yd.? Draw a graph that can be used in changing yards to feet, and from it tell the number of feet in 4 yd.; in 7 yd.; in 11 yd.

8. A store which buys goods in France might often need to change kilograms to pounds. **A kilogram (kg.) is about 2.2 lb.** Draw a graph for changing kilograms to pounds, and from it find the number of pounds in 5 kg.; in 7 kg.; in 10 kg.

9. The **kilometer (km.)**, also used in France, **is about 0.6 mi.** Draw a graph for changing kilometers to miles, and from it find the number of miles in 10 km.; in 15 km.; in 25 km.

1. Graphs in the form of pictures, called **pictorial graphs,** are often an effective and interesting way of telling a story. In an article about the use of machinery in factories here and

America

Great Britain

Japan

abroad, it was stated that the American worker has an average of 4 H.P. of power-driven machinery to help him in his work, the British worker has 2 H.P., and the Japanese worker has only 1 H.P. How does the above graph tell the story?

2. From the graph of Ex. 1, what reasons can you give for wages being higher in America than in Great Britain or Japan?

3. A college recently reported that 50 yr. ago 80% of its graduates went into professional work, becoming doctors,

50 yr. ago

Today

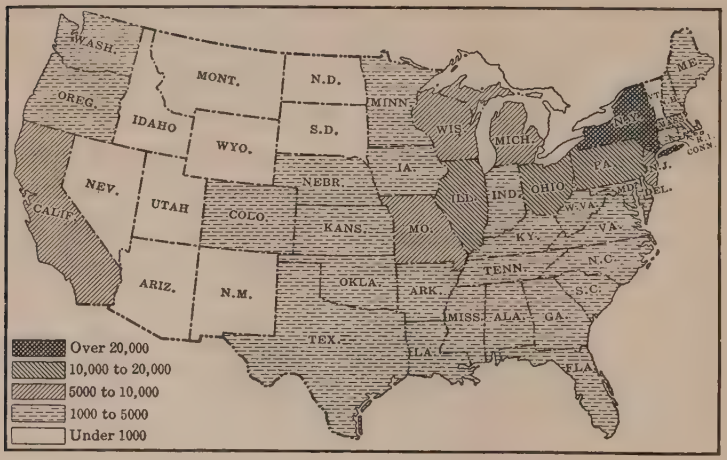
lawyers, ministers, and the like, and 20% went into business. What does the graph tell about the graduates of today?

4. If the per cents given in Ex. 3 had been 70% and 30%, what changes would have to be made in the graph?

Map Graphs

SOME corporations do business in practically every state, and so they often need to make a study of statistics which relate to the country as a whole. In making such studies, **map graphs** are frequently of great assistance.

1. The map below, which shows the **distribution of manufacturing plants** in this country, is shaded in five different



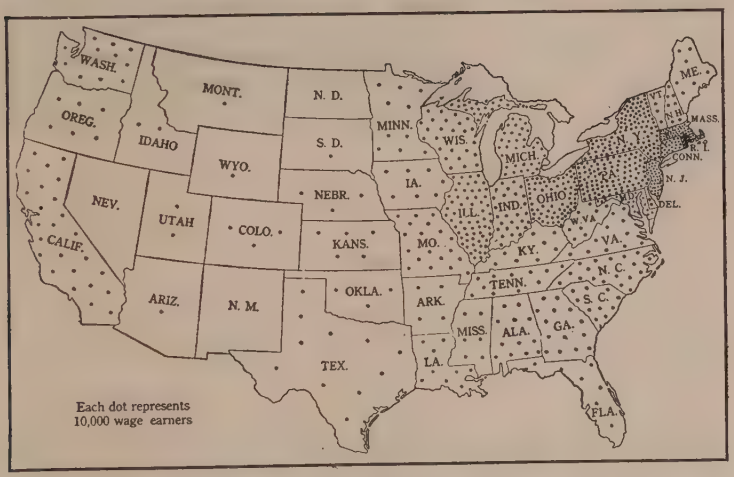
ways to show the approximate number of plants in each state. Which state has more than 20,000 manufacturing plants?

2. In Ex. 1, which states have less than 1000 manufacturing plants each? Which states have from 1000 to 5000 plants each? Which states have from 5000 to 10,000 plants each? Which have from 10,000 to 20,000 plants each?

3. From the map, make a list of the states that you would include in what is often called "our industrial section."

4. From the map on the opposite page, tell why a company that manufactures a product sold only to factories might let one agency serve several states like Nevada, Utah, and Arizona, and establish at least one agency each in New York, Ohio, Pennsylvania, Illinois, and Massachusetts.

5. The map below shows the **number of workers in manufacturing plants,** as distributed by states. Each dot repre-

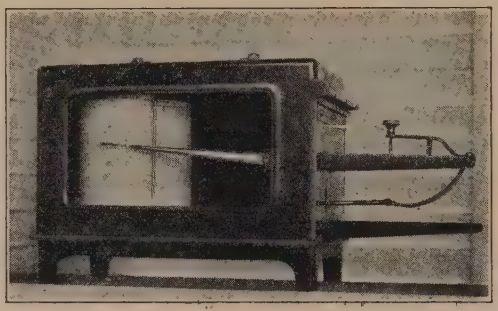


sents 10,000 workers (to the nearest 10,000). For example, New York has 107 dots and Pennsylvania has 100. New York has what per cent more workers than Pennsylvania?

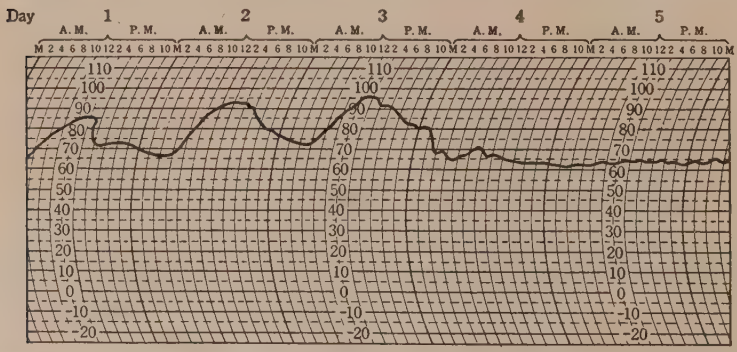
6. A state without any dot has less than 5000 workers in its manufacturing plants. In which states is this the case?

7. Without counting the dots, make a list of the 5 states which appear to have the most workers. After comparing the above map with the one on the opposite page, write a statement giving reasons why these states have the most workers.

AT THE Weather Bureau in Washington, D. C., and at its branches throughout the country, very careful records of the weather are kept. In keeping track of the temperature, **self-recording thermometers**, like the one here shown, are used. These devices automatically record the temperature throughout the day and night by means of a pen which traces a graph on a strip of paper wound around a drum that turns by clockwork.

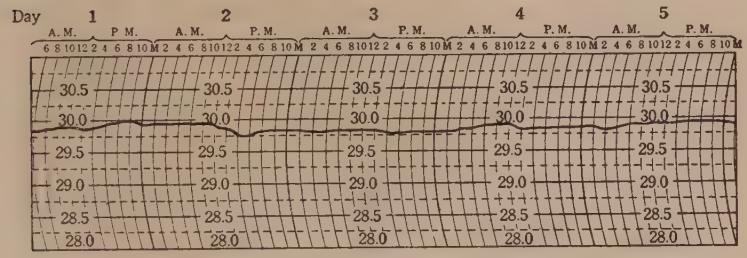


1. Here is a record of the temperature, as traced by a self-recording thermometer, for the first five days of September:



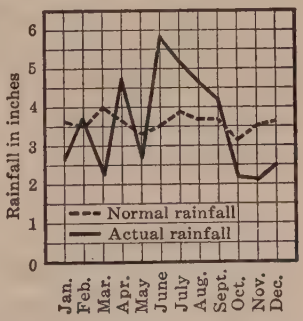
From the above graph, find, as closely as you can, the temperature for each day at 8 A.M., noon, and 6 P.M.

2. Records are also kept of the readings of the **barometer,** an instrument for measuring the **atmospheric (air) pressure.** A "rising barometer" generally indicates fair weather; a "falling barometer," stormy weather. Here is the barometer record for the same five days as the record on page 368:



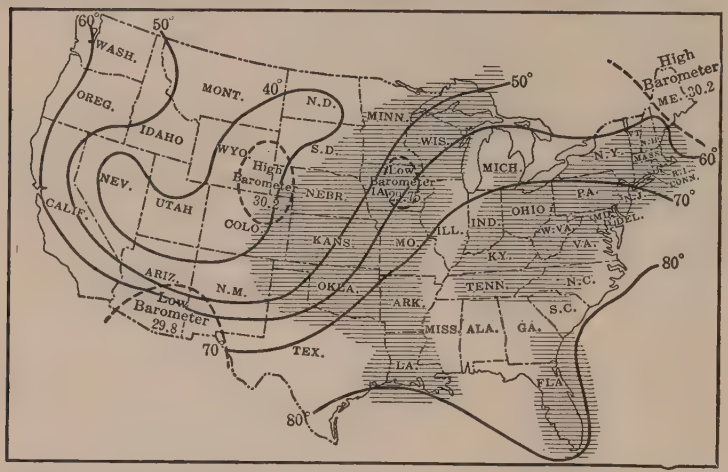
Barometers are read in inches, a reading of 29.85 meaning 29.85 in. From the graph, find, as closely as you can, the barometer reading for each day at 8 A.M., noon, and 6 P.M.

3. The amount of rain that falls at a station of the Weather Bureau is carefully measured and recorded. Here is a graph which shows how the actual rainfall by months compared one year with the normal, or average, rainfall as determined from the records for a number of years. In what months was the rainfall above the average? In what months was it below?



4. In Ex. 3, the actual total rainfall for the year was 0.30 in. less than the normal total rainfall. By finding how much each month was above or below normal, see how closely you can verify this statement from the graph.

THE Weather Bureau publishes each day a map showing the weather conditions throughout the country. Here is such a map, considerably simplified so you can study it easily:



The wavy lines join points which have the same temperature that day at 8 A.M. These lines are drawn for every 10° of difference in temperature. The shaded portions show areas in which more than 0.01 in. of rain fell during the preceding 24 hr. "High-pressure areas" and "low-pressure areas," as indicated by the barometer, are shown by the dotted lines.

1. In the above map, what was the approximate temperature in Ohio? in Arkansas? in New York?

2. In what states did it rain during the previous 24 hr.?

3. In what states was there a low-pressure area? In what states was there a high-pressure area?

1. In a school of 320 pupils, 20% come to school by trolley and 35% by bus. How many pupils come each way?

2. Mr. Williams is borrowing \$1200 from his bank at $5\frac{1}{2}\%$. How much interest will he have to pay for 3 mo.?

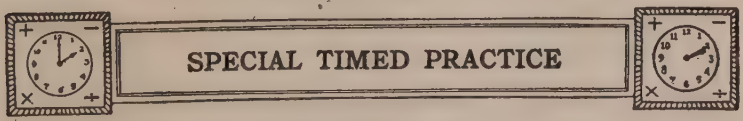
3. In a junior high school in which there are 650 pupils enrolled, 247 of them are in the eighth grade. What per cent of the pupils are in that grade?

4. In Ex. 3, if the average daily attendance at the school is 98% of the number enrolled, how many pupils, on the average, are in school each day? are absent each day?

5. One air-mail line carried 750,000 lb. of mail last year. At 5¢ an ounce, how much was the postage on this mail?

6. An investor bought 75 shares of stock when it was quoted at $104\frac{1}{2}$. Including the usual brokerage of \$15 per 100 shares, how much did the stock cost him?

7. An investor bought 12 bonds, each with a face value of \$1000, at $96\frac{3}{4}$. Including the usual brokerage of \$2 per \$1000 of face value, how much did the bonds cost him?



Time: 10 min.

1. $12.768 + 0.249 + 3.007 + 35.600 - 12.255 - 13.870$

2. $4.04 + 9.60 + 0.53 + 12.66 + 5.05 - 3.01 - 12.09$

3.	4.	5.	6.	7.
562×3.8	8.02×0.43	74.5×106	0.432×0.8	0.098×0.033

8. $80.2\overline{)68.972}$ 9. $7.45\overline{)2.384}$ 10. $0.702\overline{)68796}$

1. How do you check your work in addition? in subtraction? in multiplication? in division?

2. How do you find $16\frac{2}{3}\%$ of \$660? $37\frac{1}{2}\%$ of \$792? What is the answer in each case?

3. What is a short method of multiplying by 25? dividing by 25? multiplying by 125? dividing by 125?

4. How many quarts are there in $1\frac{1}{2}$ gal.? in $1\frac{1}{2}$ bu.?

5. What is the ratio of 9 to 27? of 27 to 9? of 9 in. to 27 in.? of 27 in. to 9 ft.?

6. Which, if either, is the greater, 0.05 or $\frac{1}{2}\%$?

7. What common denominator would you use in adding the fractions $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{2}{3}$?

8. In finding 39.6% of \$2250, what fraction would you use in estimating the answer? What is your estimate of it?

9. In the proportion $\frac{*}{7} = \frac{15}{35}$, what number should go in place of the star?

10. Complete this statement: A circular graph is a good way to represent statistics expressed as ——.

11. How much butter fat will be obtained from 3850 lb. of milk that tests 4.2% butter fat?

12. In a plan of a house drawn to the scale of 1 in. to 8 ft., what is the ratio of the length of one of the rooms in the plan to the actual length of the room?

13. When a corporation pays a dividend of $5\frac{1}{2}\%$, how much is received by the owner of 65 shares of the company's stock, which has a par value of \$100 per share?

14. When the rate of exchange is $\$4.85\frac{1}{2}$ to the pound (£), how much will it cost for an English draft for £120?

CHAPTER SEVEN

OUR GOVERNMENT AND OURSELVES

I. THE COST OF GOVERNMENT

What Governments Do

DO YOU know how much a modern public-school building costs? Where does the money to build it come from? Who pays the running expenses of such a school?

Building and maintaining a school system is only one of many things that governments do for the people. Here is a partial list of other activities of governments:

Roads	**Parks**	**Courts**
Bridges	**Water supplies**	**Lighthouses**
Libraries	**Army and Navy**	**Postal service**
Hospitals	**Fire departments**	**Police departments**

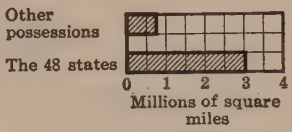
1. City, county, and state governments all build roads, and in some cases the national government pays part of the cost. Who builds the roads in the place where you live?

2. Separate the above list into three lists showing the activities that are supported chiefly by (1) city governments, (2) state governments, and (3) the national government.

3. Add to the lists that you made in Ex. 2 any other items about which you know, and mark them with a star (*).

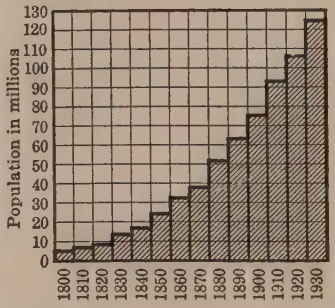
YOU live in a large country. **Do you know how large it really is?** The problems on this page will give you some idea of its size, which will help you in studying about our national government and the cost of running it.

1. This graph shows the area in square miles of the 48 states and of our other possessions, such as Alaska, Hawaii, the Philippine Islands, and the like. Estimate from the graph the area of the 48 states; the area of the other possessions. What is the total area that our national government controls?



2. There are 640 A. in a square mile. About how many acres are there in the 48 states?

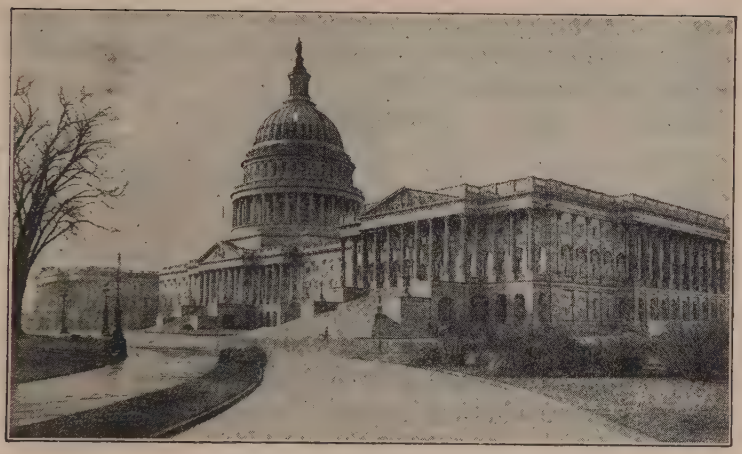
3. This graph shows how the number of people in our country has increased since 1800. Estimating as closely as you can, tell from the graph what our population was at each 10-year period from 1900 to 1930.



4. The population in 1920 was how many times that in 1820? It was what per cent greater than that in 1910? in 1900?

5. From the two graphs, find for 1920 the average number of people per square mile in the 48 states.

6. In one of our eastern states, the population per square mile in 1920 was 566. This is how many times as great as the average found in Ex. 5?



1. The United States government is a business of tremendous size. Its expenses vary from year to year, but they now **average about $3,750,000,000 a year.** Taking 365 da. to the year, find to the nearest $1,000,000 the expenses per day.

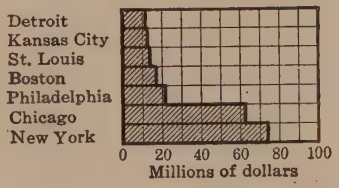
2. Just for fun, find from the answer to Ex. 1 the expenses per minute, giving the answer to the nearest $1000.

3. The government receives about $700,000,000 a year from the operation of the postal service, which pays most of the cost of this department. Taking 365 da. to the year, find to the nearest $100,000 the receipts per day.

4. In a recent year the expenses of the government were about $3,643,500,000. Taking the population that year as 120,000,000, find to the nearest cent the cost per person.

5. During the World War, the cost per person of our national government one year was $176.40. This was how many times as great as the cost found in Ex. 4?

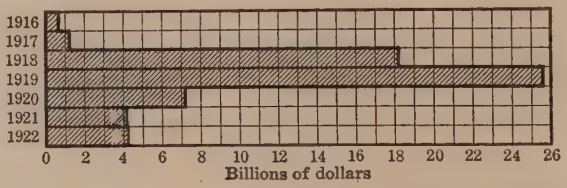
1. This graph shows for a recent year the postal receipts in several of our largest cities. Estimate from the graph as closely as you can the number of millions of dollars taken in at each of these post offices.



2. The receipts in New York were what per cent greater than in Chicago? in Philadelphia?

3. In Ex. 1, what was the approximate total amount taken in at the seven post offices? If the total receipts from the whole country that year were $700,000,000, the receipts in these cities were what per cent of this total?

4. This graph shows the amounts appropriated yearly by Congress for a period of 7 yr. Which years show the enormous amounts that had to be appropriated in order to pay the cost of the World War? What was the greatest amount appropriated in any year?



5. In Ex. 4, the appropriations in the year 1918 were how many times as great as those of 1916? The appropriations in 1922 were what per cent of those in 1919?

6. In Ex. 4, the appropriations for 1922 were how much greater than for 1916? They were what per cent greater?

7. Do you know how long it takes to count a billion? Suppose that you have $1,000,000,000 in 100-dollar bills, and that you can count 60 bills per minute. Working 8 hr. a day, how long, to the nearest day, would it take you?

OUR state governments do not, of course, spend as much as the national government, but **in all they spend about $1,750,000,000 a year.** The expenses of each state naturally vary according to its size and population.

1. In a recent year the expenses of the government of the State of New York were about $230,000,000. To the nearest 1%, this was what per cent of the total given above?

2. In another state in which the total expenses one year were about $86,900,000, the amount spent for education was about $25,098,000. To the nearest 0.1%, this was what per cent of the total spent by the state government?

3. In the same year as in Ex. 2, there were approximately 1,135,000 pupils in schools throughout the state. Find to the nearest cent the amount that the state government spent per pupil on education.

4. In a third state the amounts spent one year for various purposes were as follows: state institutions, $14,822,000; public works, including highways, $14,437,000; public welfare, including education, $12,709,000; other activities, $3,111,000; executive and administrative, $1,465,000; interest on state debt, $1,261,000; courts, $1,247,000; reduction of state debt, $1,100,000; collection of taxes, $697,000; legislature, $689,000. What was the total amount spent?

In Ex. 4, find to the nearest 1% the per cent of the total that was spent for each of these purposes:

5. Courts.
6. Legislature.
7. Public welfare.
8. State institutions.
9. Interest on state debt.
10. Executive and administrative.

THE cost of government in cities, towns, and villages varies from that of a small community which spends only a few thousand dollars a year to that of New York City which spends **more than half a billion dollars a year.**

In many states there are also county governments which maintain schools and courts, build roads and bridges, and carry on other activities for the public benefit.

---

1. In a recent year the government of New York City spent $512,528,000. Of this, $58,000,000 was for police protection. To the nearest 0.1%, this was what per cent of the total?

2. In Ex. 1, the population that year was about 6,020,000. What was the cost per person of the city government?

3. In a community having a population of 10,200, the amounts spent one year by the local government were as follows: executive and administrative, $45,800; protection of persons and property, $63,050; health and sanitation, $28,550; public charities, $17,000; highways and bridges, $147,800; education, $210,600; parks, $7800; interest and debt reduction, $85,600; state taxes, $60,100; county taxes, $21,250. What was the total amount spent?

4. In Ex. 3, what was the cost per person of the local government that year? This is how much more or less than the cost of government in New York City, as found in Ex. 2?

In Ex. 3, find to the nearest 1% the per cent of the total that was spent for each of these purposes:

5. Parks.

6. Education.

7. Public charities.

8. Highways and bridges.

9. Taxes paid state government.

10. Protection of persons and property.

SOME of these problems cannot be solved because **not enough is given**; in others **more is given than you will need to use.** You will have to **keep alert and think straight.**

Solve as many of these problems as you can and tell why the others cannot be solved:

1. Helen had $2 with which to buy tickets to the movies for herself and 2 friends. How much did she have left?

2. One year when the price of cotton was $108 a bale, a Georgia farmer raised an average of 225 lb. of cotton per acre on 80 A. How many 500-pound bales did he have to sell?

3. A community having a population of 14,800 paid $80,720 last year as its share of the expenses of the state government. To the nearest cent, how much was this per person?

4. Mr. Kane's records show that last month 5 of his cows produced a total of 1250 lb. of milk testing 4.1% butter fat. At 30¢ a pound for butter fat, how much did he get for it?

5. How much more will it cost to buy a 12-pound turkey at 50¢ a pound than 2 ducks weighing 6 lb. each?

6. Mrs. Fox has 150 hens. If she sells 15 doz. eggs at 40¢ a dozen, how many more hens, at 75¢ each, can she buy with the money that she receives for the eggs?

7. A farmer bought some land 5 yr. ago for $32,000. It is now worth $350 per acre. If he sells it at this price, how much will he gain per acre?

8. In an endurance test an automobile was driven 1142 mi. in 2 da. 5 hr. 17 min. At 21¢ a gallon, how much did the gasoline for the trip cost?

Tell how you would solve each of these problems if the numbers that belong in the blank spaces were given:

1. It cost —— boys a total of $—— for a camping trip that lasted —— da. What was the average cost per boy per day?

2. In a year when the total expenses of the national government were $——, the interest on the public debt amounted to ——% of this total. How much was the interest?

3. The budget of the Stone family allows $—— for coal for the winter. At $—— per ton, how many tons will this buy?

4. A city spent $—— last year for schools and $—— for police protection. What per cent more (or less) did the city spend for schools than for police protection?

5. During the —— yr. that he has owned his house, the value of Mr. Brent's property has increased from $—— to $——. What has been the average yearly increase?

6. In a western state the expenses of the governor's office amounted to $—— last year, which was ——% of the total cost of the government. What was the total cost?

7. When a city increases the pay of its laborers from $—— to $—— per day, what per cent of increase is granted?

8. Mr. Drew sold the grocer —— lb. of cabbages at ——¢ per pound. At ——¢ per pound, how many pounds of flour can Mr. Drew buy with the money that the grocer paid him?

9. A city borrowed $—— at ——% by issuing bonds. If ——% of the total bond issue is paid off each year, by how much will this reduce the yearly interest?

10. In building a road that cost $——, the national government paid ——% of the cost, the state paid ——%, and —— cities paid ——% each. What was the share of each?

See if you can do these additions correctly:

1.	2.	3.
$15,286.00	$60,250.00	$120,346.50
8,164.50	48,117.50	89,275.00
22,368.40	88,256.40	140,168.40
7,500.00	19,342.30	75,250.00
13,809.72	50,500.00	365,287.10
5,104.80	68,336.80	82,340.40
18,297.50	72,105.60	256,875.00

See if you can do these subtractions correctly:

4.	5.	6.
$76,854.00	$56,207.17	$872,675.50
19,274.50	39,856.49	98,784.75
7.	**8.**	**9.**
$82,568.25	$18,270.68	$625,842.92
44,892.80	7,584.96	347,956.87

Multiply or divide, as indicated:

10. 12,200 × $58.67

11. 365 × $108,250

12. 15.6 × $47,758.50

13. $10,400 ÷ $130,000

14. $633,726 ÷ 10,200

15. $53,279,520 ÷ 4,242,000

Find these per cents:

16. 5% of $40,500

17. $4\frac{1}{2}$% of $128,500

18. $5\frac{1}{2}$% of $682,000

19. $12\frac{1}{2}$% of $876,400

20. $16\frac{2}{3}$% of $12,570,000

21. $37\frac{1}{2}$% of $96,800

22. 25% of $160,250

23. $33\frac{1}{3}$% of $1,650,000

24. 45% of $8,726,000

25. 98% of $104,600,000

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. A grocer finds that potatoes averaging 8 oz. each sell best. How many of these potatoes are there in a bushel (60 lb.)?

2. Of the 320 pupils in the Hale School, 48 are over 14 yr. of age. What per cent of the pupils are over this age?

3. The 11,000 sq. mi. of rice fields in Japan represent 56% of the cultivated land. What is the cultivated-land area?

4. In round steak the waste is estimated at $8\frac{1}{2}$%. How many ounces of waste are there in $2\frac{1}{2}$ lb. of this steak?

5. How many 6-inch squares of paper can be cut from a sheet that is 18 in. by 24 in.?

6. When a merchant borrows \$3000 for 20 da. at 6%, how much interest does he have to pay?

7. At $3\frac{1}{4}$ lb. to the acre, how many acres can be planted with $8\frac{1}{8}$ lb. of Bermuda onion seed?

8. How many cubic inches are there in a cake of artificial ice that is 52 in. by $22\frac{1}{2}$ in. by 10 in.?

9. A Utah farmer raised 180 T. of sugar beets on $12\frac{1}{2}$ A. What was the average yield in tons per acre?

10. St. Louis and Kansas City are 9 hr. 10 min. apart by bus and 2 hr. 45 min. apart by air. Traveling by air between these cities takes what per cent of the time by bus?

The National Government's Income

YOU have seen that our various governments spend large sums of money. Most of the national government's income comes from (1) **taxes on goods brought in from foreign countries** and (2) **taxes on the incomes of persons and corporations.**

The taxes on goods brought in from foreign countries are called **duties on imports.** These taxes are collected at **custom-houses** located at harbors on our coasts or at places along the Canadian and Mexican borders.

The taxes on incomes are called **income taxes.** Every person or corporation having a yearly income above a certain amount has to pay a part of that income to the government.

---

1. In a recent year the United States government collected about $569,000,000 in duties on imports and $2,175,000,000 in income taxes. To the nearest 0.1%, the duties were what per cent of the income taxes?

2. In the same year as in Ex. 1, the people of Illinois paid about $201,000,000 in income taxes. To the nearest 0.1%, Illinois paid what per cent of the total income taxes?

3. In the same year as in Ex. 1, the people of New York paid $646,000,000 in income taxes, the people of Pennsylvania paid $217,000,000, and the people of California paid $114,000,000. New York paid what per cent more income taxes than Pennsylvania? California paid what per cent less than New York?

4. In a year when a man with an income of $12,000 has to pay the government an income tax of $168.75, what per cent of his income, to the nearest 0.1%, does he pay?

GOODS brought into this country are taxed (1) **to secure money to help run the government** and (2) **to protect American industry.** Wages in some foreign countries are much lower than here, and so goods can be manufactured more cheaply there. If such goods were not taxed, it would lower American wages.

The duty on some goods is said to be **ad valorem,** which means a certain per cent of the value. On others the duty is **specific**; that is, it is a specified amount per pound, per bushel, or the like. Still other goods are **on the free list,** and no duty at all is charged.

The picture shows a customs inspector examining the baggage of two passengers who are returning from abroad.

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1. On dolls made in foreign countries the duty is 70%. Is this an ad valorem or a specific duty?

2. Sheep imported into this country are taxed $2 a head. Is this an ad valorem or a specific duty?

3. Farm implements are on the free list. See if you can give one or more reasons why this should be so.

4. On writing paper there is both a specific duty of 3¢ a pound and an ad valorem duty of 15%. On 500 lb. worth $200, the specific duty is 500 × $0.03, or $15, and the ad valorem duty is 0.15 × $200, or $30. What is the total duty?

5. On unhemmed handkerchiefs the duty is 35%. Find the duty on a shipment valued at $1850; at $3148; at $8780.

6. On olive oil the duty is $6\frac{1}{2}$¢ per pound. Find the duty on a shipment weighing 800 lb.; 1750 lb.; 5760 lb.

7. On goods manufactured from artificial silk there is a specific duty of 45¢ per pound and an ad valorem duty of 60%. What is the total duty on 360 lb. valued at $1275?

In each of these cases, find the total duty to be paid:

	Nature of Goods	Amount Imported	Total Value	Rate of Duty	
				Ad Valorem	Specific
8.	Butter	1200 lb.			12¢ a pound
9.	Corn	8000 bu.			15¢ a bushel
10.	Rugs		$18,500	55%	
11.	Damask		$22,000	40%	
12.	Shears	1440	$1152	45%	20¢ each
13.	Automobiles		$80,000	25%	
14.	Cigars	1800 lb.	$14,400	25%	$4.50 a pound
15.	Dyes	600 lb.	$480	45%	7¢ a pound
16.	Ink		$1800	20%	
17.	Aluminum	1800 lb.			5¢ a pound
18.	Perfumery	400 lb.	$1250	75%	40¢ a pound

THE United States government receives each year **more than $2,000,000,000 in income taxes.** Of this amount, about $1,250,000,000 is paid **by corporations,** and the rest **by individuals** who have incomes larger than the amounts specified in the income-tax law as exempt from taxation.

In finding the amount of tax due the government, the individual first deducts from the amount of his yearly income the allowances to which he is entitled. The amount of the tax is then computed as a per cent of this balance.

The rates increase according to the size of the income, so that people with large incomes pay more in proportion than people with small incomes.

For example, suppose that Mr. Howard's salary one year was $7500. He was allowed an exemption of $3500 on account of being a married man and $400 each for his two small children. The rate on the taxable balance was $1\frac{1}{2}\%$. His so-called "normal tax" was therefore $48. He was then allowed to deduct 25% of this normal tax, because his salary was classed as "earned income" and not as income received from invested savings. The amount of tax due the government that year was therefore $36.

$7500	← Salary
− 4300	← Exemption
$3200	← Taxable balance
× 0.01$\frac{1}{2}$	← Rate of tax
$48.00	← Normal tax
− 12.00	← Take off $\frac{1}{4}$ (25%)
$36.00	← Tax due

The income-tax law is very complex, and the details change frequently. You should, however, **try to understand the general principle of this tax which produces so large a part of our government's income.**

1. Mr. Green's exemption is \$3500. If his income one year was \$6300, what was the taxable balance? At $1\frac{1}{2}\%$, what was his normal tax? Deducting 25% for earned income, what was the amount of tax due the government?

2. Mr. Ray is not married, and so his exemption is \$1500. If his income was \$3800, what was the taxable balance? At $1\frac{1}{2}\%$, less 25% for earned income, what was his income tax?

3. In a year when the normal tax rate on the first \$4000 of the taxable balance is $1\frac{1}{2}\%$, what is the normal tax on the first \$4000 of a balance of \$7280? If the remainder is taxed at 3%, what is the amount at this rate? What is the total? Deducting 25% for earned income, how much tax is due?

4. On large incomes an extra tax, called a **surtax**, is collected in addition to the normal tax. On an income of \$20,000 the surtax is \$220. This is what per cent of the income?

5. Some states also have an income tax. In a year when a man had to pay $1\frac{1}{2}\%$ on a taxable balance of \$3847.64, what was the amount of the tax that he paid the state government?

Taking the normal tax rate as $1\frac{1}{2}\%$ of the taxable balance, find the amounts that belong in the blank columns, as in Ex. 6:

	Amount of Income	Amount of Exemptions	Taxable Balance	Normal Tax	Deduction of 25%	Tax Due
6.	\$3875.50	\$1500	\$2375.50	\$35.63	\$8.91	\$26.72
7.	\$4285.75	\$3500				
8.	\$5890.40	\$3900				
9.	\$6280.36	\$4300				
10.	\$7586.72	\$4300				

1. When the duty on silk cloth is 55% ad valorem, what is the total duty on a shipment valued at $3260?

2. On steel wool the duty is 10¢ a pound and 30% ad valorem. What is the total duty on a shipment weighing 1250 lb. and valued at $218?

3. At $1\frac{1}{2}$%, how much is the normal income tax on a taxable balance of $3428.16? Deducting 25% for earned income, what is the amount of tax due?

4. Mr. Dole's income one year was $4265, of which $3500 was exempt. At $1\frac{1}{2}$% on the taxable balance, less 25% for earned income, how much was his income tax?

5. At $1\frac{1}{2}$% on the first $4000, 3% on the second $4000, and 5% on all over $8000, what is the total normal tax on a taxable balance of $10,847.50?

See how quickly you can do these examples:

6. $1284	7. $0.22	8. $1.04	9. $6855
$\times$ 0.45	$\times$ 150	$\times$ 1200	$\times$ $0.33\frac{1}{3}$
10. $6850	11. $7848.50	12. $12,326	13. $20,877.38
$-$ 4300	$-$ 1500.00	$-$ 3,900	$-$ 4,700.00

Find these per cents:

14. $1\frac{1}{2}$% of $3859.60
15. 3% of $3697.17
16. 5% of $5876.20
17. $1\frac{1}{2}$% of $12,856.08
18. 30% of $4850
19. $33\frac{1}{3}$% of $12,256.50
20. 40% of $25,280.25
21. 45% of $30,276.80

MOST of the money to run the state, county, and local (city, town, or village) governments comes from **taxes on buildings, land, and other property.** Each property owner pays according to the amount of property that he owns; for example, a man who owns $25,000 worth of property pays five times as much as one who owns only $5000 worth.

Each year, officers called **assessors** determine the value of each piece of property. This value is called the **assessed valuation** of the property. After the amounts that will be needed to pay the expenses of the local government, including the amounts that the community must pay towards the support of the state and county governments, have been determined, **the tax rate for the year** is then computed.

For example, suppose that in a community having a total assessed valuation of $20,000,000 it is necessary to raise $440,000 in order to pay the year's expenses of the local government and the community's share of the cost of the state and county governments. You can easily see that

$20,000,000 must yield $440,000,
and so $10,000,000 must yield $220,000,
or $10,000 must yield $220,
or $10 must yield $0.220, or 22¢,
or $1 must yield $0.022, or 2.2¢.

In tax problems, the **mill (0.1¢)** is frequently used, and so the last relation above could be stated as

$1 must yield 22 mills.

Property-tax rates are generally stated as so many mills on $1, as so much per $100, or as so much per $1000. Thus, in the above case, the tax rate for the year might be announced as **22 mills on $1,** as **$2.20 per $100,** or as **$22 per $1000.**

FROM the preceding page, you can see that finding the tax rate is simply finding how much each dollar (or each \$100 or \$1000) of the assessed valuation must be taxed.

Tax rate = amount to be raised ÷ total assessed valuation.

For example, suppose that a small community having a total assessed valuation of \$8,000,000 must raise \$188,000 by taxation in order to pay the expenses of the local government for the year. Dividing as shown, the quotient is 0.0235.

$$8{,}000000 \overline{)\,188000}\quad 0.0235$$

The year's tax rate may therefore be stated as 23.5 mills on \$1, as \$2.35 per \$100, or as \$23.50 per \$1000.

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1. If a city with an assessed valuation of \$50,000,000 has to raise \$990,000 to meet the year's expenses, what will be the tax rate in dollars per \$1000?

2. Sometimes the money for schools is raised by a separate tax. If a school district having an assessed valuation of \$12,500,000 has to raise \$93,750, what will be the tax rate in mills on \$1?

Find the tax rate in mills on \$1 when the amount to be raised and the total assessed valuation are as follows:

3. \$26,375, \$4,220,000
4. \$73,440, \$8,640,000
5. \$138,800, \$11,650,000
6. \$383,376, \$15,648,000

Find the tax rate in dollars per \$1000 when the amount to be raised and the total assessed valuation are as follows:

7. \$233,618, \$12,628,000
8. \$320,220, \$14,825,000
9. \$728,970, \$25,850,000
10. \$112,640,900, \$4,250,600,000

AFTER the tax rate for the year has been determined, each person is notified of the amount that he must pay. For example, suppose that Mr. Sinclair's property is assessed at $6800. In a year when the tax rate is $23.50 per $1000, he will have to pay a tax of $159.80, as shown in the work at the right.

$23.50 ← Rate per $1000
6.8 ← $\frac{1}{1000}$ of assess. val.
18 800
141 00
$159.800 ← Amount of tax

Amount of tax = $\frac{1}{1000}$ of assessed valuation × rate.

When the rate is expressed in dollars per $100, the amount of the tax is $\frac{1}{100}$ of the valuation times the rate; in mills on $1, the tax is the valuation times the rate in mills.

1. Mr. Lake's property is assessed at $12,400. When the rate is $17.60 per $1000, what is the amount of his tax bill?

2. At $2.18 per $100, what is the amount of the tax paid on property that is assessed at $7800?

Find the amount of the tax bill when the assessed valuation and the tax rate are as follows:

3. $8400, 12.7 mills on $1
4. $12,500, $2.45 per $100
5. $6200, 26.2 mills on $1
6. $25,000, $2.87 per $100
7. $16,800, $21.90 per $1000
8. $18,200, $28.40 per $1000
9. $76,500, $18.80 per $1000
10. $125,000, $24.80 per $1000

11. Mr. West's property is assessed at $8200, and his tax bill is $185.32. What is the rate in dollars per $1000?

LAND and buildings, such as houses, barns, factories, hotels, and the like, are called **real estate.** Money, stocks, bonds, furniture, cattle, automobiles, and other kinds of property not fixed to the land or to some building are called **personal property.** In many places, **property taxes are collected on both real estate and personal property.**

In each of these cases, first find the total assessed valuation and then find the amount of the tax that each person has to pay:

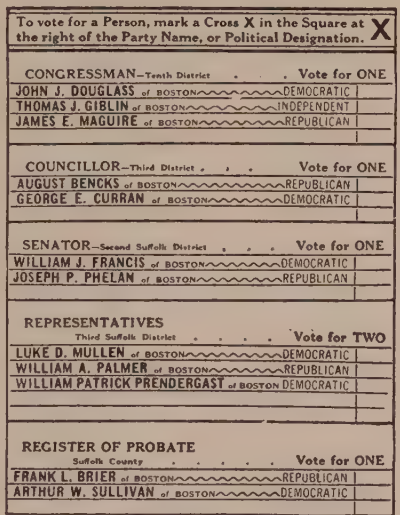
	Property Owner	Assessed Valuation		Tax Rate in Place Where Owner Lives
		Real	Personal	
1.	F. L. Ash	$6800	$1200	$2.06 per $100
2.	T. K. Barr	$8200	$950	$21.20 per $1000
3.	F. S. Cole	$12,000	$2500	$2.70 per $100
4.	E. L. Dame	$9800	$1350	18.5 mills on $1
5.	P. F. Edge	$14,500	$3600	$25.70 per $1000
6.	A. K. Fall	$11,800	$1450	$2.65 per $100
7.	S. M. Gore	$16,600	$3900	17.2 mills on $1
8.	J. N. Hall	$24,000	$5600	$18.20 per $1000
9.	E. R. Ives	$10,800	$1250	$2.48 per $100
10.	A. S. Jack	$32,500	$5800	$31.20 per $1000
11.	T. M. Kane	$52,000	$8500	24.5 mills on $1
12.	R. S. Lane	$72,500	$9650	$28.60 per $1000
13.	I. J. Mann	$56,200	$7200	$35.40 per $1000
14.	P. B. Noyes	$68,500	$6450	28.4 mills on $1

THE officials who manage our various forms of government and who have charge of spending the enormous sums that are raised by taxation are, in general, **elected by the people.**

Another important way of supporting the government is by **voting at the various elections** at which these officials are chosen. This picture shows a part of the **ballot** that was used at a recent state election.

Every man or woman who has the right to vote should regard this right **not only as a privilege but also as a duty,** and should vote at every election.

Good government depends upon having honest and capable officials.



To vote for a Person, mark a Cross X in the Square at the right of the Party Name, or Political Designation. X

CONGRESSMAN—Tenth District . . . Vote for ONE
JOHN J. DOUGLASS of BOSTON ~~~~ DEMOCRATIC
THOMAS J. GIBLIN of BOSTON ~~~~ INDEPENDENT
JAMES E. MAGUIRE of BOSTON ~~~~ REPUBLICAN

COUNCILLOR—Third District . . . Vote for ONE
AUGUST BENCKS of BOSTON ~~~~ REPUBLICAN
GEORGE E. CURRAN of BOSTON ~~~~ DEMOCRATIC

SENATOR—Second Suffolk District . . . Vote for ONE
WILLIAM J. FRANCIS of BOSTON ~~~~ DEMOCRATIC
JOSEPH P. PHELAN of BOSTON ~~~~ REPUBLICAN

REPRESENTATIVES
Third Suffolk District . . . . Vote for TWO
LUKE D. MULLEN of BOSTON ~~~~ DEMOCRATIC
WILLIAM A. PALMER of BOSTON ~~~~ REPUBLICAN
WILLIAM PATRICK PRENDERGAST of BOSTON DEMOCRATIC

REGISTER OF PROBATE
Suffolk County . . . . . Vote for ONE
FRANK L. BRIER of BOSTON ~~~~ REPUBLICAN
ARTHUR W. SULLIVAN of BOSTON ~~~~ DEMOCRATIC

In most elections the person receiving the largest number of votes is elected. For example, in an election for governor, if Mr. A receives 120,000 votes, Mr. B receives 70,000, and Mr. C receives 30,000, Mr. A will be elected **by a plurality of 50,000 votes.** This means that he receives **50,000 more votes** than the next highest man (Mr. B).

In all there were 220,000 votes cast, and so Mr. A received 10,000 more than half of all the votes. That is, he received **a majority (more than half) of the votes,** but in most elections a majority is not necessary; in fact, he would have been elected if he had received only one vote more than Mr. B.

1. In an election for class president, John Stone received 36 votes, Roy Davis received 28, and Arthur Hatch received 15. By what plurality was John elected?

2. In Ex. 1, what is the smallest number of votes that a candidate would have to have in order to receive a majority of the votes? John had how many more or less than this?

3. In the election for class secretary, Alice Shaw received 43 votes and Kate Green received 36. By what plurality was Alice elected? Did she receive a majority of the votes?

4. When Herbert Hoover was elected president in 1928, the votes (in round numbers) of the six candidates were as follows: Hoover, 21,430,000; Smith, 15,000,000; Thomas, 268,000; Foster, 48,000; Reynolds, 21,000; Varney, 20,000. By what plurality was Hoover elected? Did he receive a majority of the votes?

5. In an election for mayor, the vote of a city was as follows: Mr. A, 17,286; Mr. B, 13,489; Mr. C, 5220; Mr. D, 176. What was Mr. A's plurality? Did he receive a majority of the votes?

In each of the following cases find which candidate was elected and by what plurality he was elected, and state whether or not he received a majority of the votes cast:

	Mr. A	Mr. B	Mr. C	Mr. D	Mr. E
6.	38,209	24,761	15,305	8726	1158
7.	8310	11,142	56,387	2665	16,256
8.	1087	18,328	2842	11,556	9621
9.	5944	1186	3827	19,956	8624
10.	20,220	83,726	50,684	31,112	13,548

1. At 12¢ per pound, find the total duty that would have to be paid in importing a shipment of $12\frac{1}{4}$ T. of butter from Canada.

2. Mr. Rice's normal income tax one year was \$56.80. If he was allowed 25% of this as a deduction for "earned income," how much did he have to pay the government that year?

3. When a man has to pay an income tax of \$33.40 on an income of \$8150, what per cent of his income, to the nearest 0.1%, does he pay to the government?

4. Mr. Wade's property is assessed at \$11,800. In a year when the property-tax rate is \$23.45 per \$1000, what is the amount of his tax bill?

5. In a city election in which a total of 129,837 votes are cast, what is the least number of votes that a candidate will have to receive in order to obtain a majority of the votes cast? Is this the same as a plurality?

See if you can do these examples correctly:

6. \$16,350	7. \$9287.40	8. 35,286	9. 128,892
$\times$ 0.45	$\times$ 0.01$\frac{1}{2}$	$-$ 19,597	$-$ 98,947

Find these per cents:

10. 45% of \$1760
11. $33\frac{1}{3}$% of \$5490
12. 60% of \$10,850
13. $1\frac{1}{2}$% of \$3652.50
14. 3% of \$2897.60
15. 5% of \$8845.30
16. 3% of \$12,856.70
17. $12\frac{1}{2}$% of \$45,488.40

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. Helen bought a dress that was marked \$22.50. If she was allowed a discount of 10%, how much did she pay for the dress?

2. At 2 for 35¢, how much will it cost to buy a case which contains 3 doz. pineapples?

3. At an average rate of 97.5 mi. per hour, how long will it take an airplane to go 682.5 mi.?

4. Allowing $1\frac{1}{4}$ cu. ft. to the bushel, find the capacity in bushels of a bin that is 10 ft. by 8 ft. by 7 ft.

5. An agency charged $7\frac{1}{2}$% for collecting an overdue bill amounting to \$240. How much was the charge?

6. A grocer borrowed \$1650 for 30 da. At 6%, how much interest did he have to pay?

7. At a yearly rate of 24¢ per \$100, how much will it cost per year to insure a house for \$8500 against loss by fire?

8. Taking 39.37 in. to the meter, find to the nearest yard the length of the 400-meter race in the Olympic Games.

9. At 35% ad valorem, find the total duty paid on a shipment of wearing apparel valued at \$3240.

10. In a triangular lot which has a perimeter of 269.5 ft., two of the sides measure 85.7 ft. and 91.6 ft. What is the length of the third side of the lot?

Public Schools

YOU have already learned some of the things which our various governments do for the benefit of the people. A number of these will now be considered in detail. **The greatest help that governments give the individual is the opportunity to get a good education. Do not neglect this opportunity.**

1. One year the number of pupils in public schools was 19.4% of our population of 125,000,000. How many pupils were there?

2. There are in our country about 260,000 public-school buildings, of which 194,500 are elementary schools. What per cent of the schools are elementary?

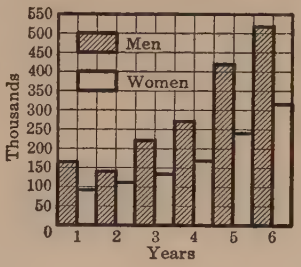
3. There are 6,400,000 pupils in the elementary grades in country schools, and 18% more than this number in the elementary grades in city schools. How many pupils are there in the elementary grades in city schools?

4. Have you ever wondered how much it costs a city per year to educate each pupil? In a recent report the sum of the yearly costs per pupil in 21 cities was given as $2088. What was the average yearly cost per pupil in these cities?

5. It is estimated that our public-school system costs about $2,000,000,000 a year. From Ex. 1, what is the average cost per pupil per year? How does this compare with the average for city schools found in Ex. 4?

6. Recently there were 800,000 pupils enrolled in city night schools in this country. California, which had $16\frac{2}{3}$% of this total, had the largest number. How many pupils were enrolled in city night schools in that state?

MANY of our colleges and universities are supported by our state governments, while others are privately supported. The number of students in colleges and universities has grown very rapidly within the last few years. This graph shows the growth in the attendance of men and women at colleges and universities during a recent 6-year period. Perhaps you are planning to go to college yourself after you have finished high school. **It is worth while to start planning now.**



1. From the above graph estimate as closely as you can for each year the number of men students; of women students.

2. In Ex. 1, by what per cent did the number of men students increase from the first to the sixth year? What was the per cent of increase for the women students?

3. In a class of 1240 pupils graduated recently from the high schools of a city, 35% went to college the next year. How many boys and girls went to college from that city that year?

4. A leading women's college reports that the average amount which is spent by each student for all purposes is $1638 per year. How much money must be invested at 5% in order to give a yearly income that will meet this expense?

5. The average yearly cost of a college education given in Ex. 4 is what per cent greater than that in a men's college at which the average spent per student per year is $1256?

6. In Ex. 5, a student who spent $1444.40 last year spent what per cent more than the average?

AS PART of the opportunities for getting an education, governments maintain free public libraries for reading and studying. **Many people who cannot afford to go to school longer continue their education in this way.**

1. In Chicago, which has 3,160,000 people, the public library circulates more than 12,000,000 books a year. In New York, which has 6,020,000 people, the public library circulates about 20,000,000 books a year. Find, to the nearest 0.1, the number of books per person circulated in each city.

2. The Library of Congress, which is in Washington, has about 4,000,000 books, and the number of maps, engravings, and the like, is 2,400,000. The latter are what per cent of the former?

3. In a year in which 4,100,000 books were circulated, the cost of running a city library was $72,570. What was the average cost per book circulated?

4. In one library, the amount spent one year for new books and periodicals was $154,400, and the amount spent for repairing and rebinding old books was $62,600. The amount spent for repairs was what per cent of that spent for new books?

5. In a community of 10,200 people, the public library contains 25,500 books. This is how many books per person?

6. In Ex. 5, the total cost of running the library one year was $9165. To the nearest cent, what was the cost per person?

7. In a city of 800,000 people, there were 148,700 people who held cards entitling them to draw books from the public library. What per cent of the population had cards?

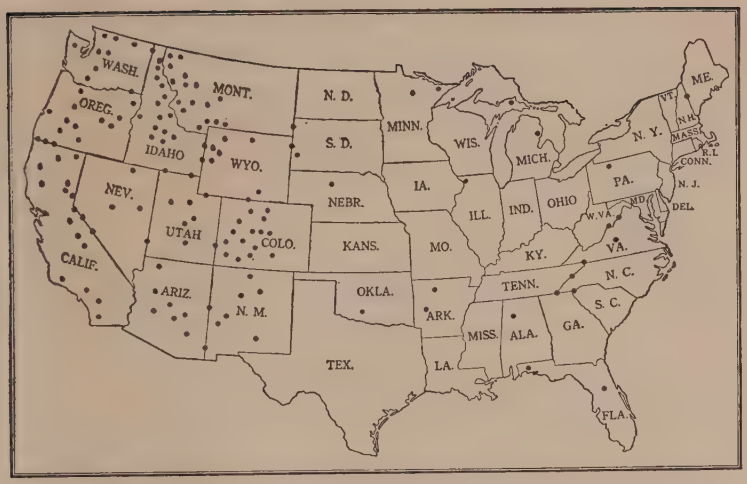
8. In a library which owns 586,342 books, the number circulated one year was 1,759,026. This is equivalent to taking out each book how many times per year?

1. The national government maintains many large tracts of land in which mountains, lakes, and forests are preserved in their natural beauty. The largest of these is Yellowstone National Park, in which are the Great Falls shown in the picture above. This park covers an area of 3348 sq. mi. How many acres (1 sq. mi. = 640 A.) does the park cover?

2. The second largest park in the United States is Glacier National Park, in Montana, which covers 1534 sq. mi. This is what per cent as large as Yellowstone Park (see Ex. 1)?

3. Sequoia National Park, in California, which contains 604 sq. mi., has 12,000 trees over 10 ft. in diameter. This is an average of how many of these large trees per square mile?

4. In Rocky Mountain National Park, in Colorado, one of the mountains is 14,255 ft. high. To the nearest 0.01 mi., how high is this mountain?



1. The national government also maintains vast tracts of forest land. Each dot in the above map shows a national forest. In what part of the country are most of them located?

2. The total area of the forests shown in the map is about 138,400,000 A. How many square miles (1 sq. mi. = 640 A.) do these forests cover?

3. Our largest national forest (outside of Alaska) is the Tonto Forest (Arizona), which contains 2,262,000 A. This is what per cent of the 113,900 sq. mi. in Arizona?

4. The White Mountain Forest, which is located in New Hampshire and Maine, contains 494,000 A. This is what per cent of the area of the Tonto Forest (Ex. 3)?

5. In spite of vigilant forest patrols, in a recent year 43,931,000 A. of forest land were burned, with a total damage of about $82,934,000. What was the average damage per acre?

See how quickly you can do these additions:

1.	2.	3.	4.	5.
\$69.30	\$8.76	3 ft. 8 in.	\$5.57	\$12.35
87.84	.68	7 ft. 0 in.	3.05	84.26
.96	9.77	5 ft. 7 in.	4.79	82.44
89.87	6.97		7.55	5.93
9.09	.89		5.68	41.38

6. From the sum of $5.124 + 2.215 + 2.232 + 6.423$ subtract the sum of $1.011 + 3.008 + 2.931 + 5.000 + 0.498$.

See how quickly you can do these multiplications:

7.	8.	9.	10.	11.
2.06	31.4	2 ft. 8 in.	0.139	$21\frac{7}{8}$
0.17	21.6	14	1.26	1.2

Copy, divide, and check by multiplication:

12. $3.04\overline{)7.46016}$ **13.** $82.6\overline{)341.964}$ **14.** $720\overline{)36.288}$

Find the answers:

15. $2\frac{7}{8} \times 3\frac{1}{2}$ **16.** $17\frac{1}{2} \div 4\frac{3}{8}$ **17.** $5\frac{1}{3} + 2\frac{1}{2}$ **18.** $5\frac{2}{3} - 2\frac{3}{4}$ **19.** 5 × 3 ft. 9 in. **20.** 3 ft. 9 in. ÷ 5

Find the missing numbers:

21. $85.8 + \text{——} = 98.2$ **22.** $462 \div 0.7 = \text{——}$ **23.** $\text{——} \times 528 = 132$ **24.** $93.7 - \text{——} = 64.8$ **25.** $32.2 = 644 \times \text{——}$ **26.** $18.6 \div 3.1 = \text{——}\%$

27. \$11.70 is $2\frac{1}{2}\%$ of \$——

28. —— in. is $8\frac{1}{3}\%$ of 1 ft.

29. 20% of —— in. is 5 in.

30. 48 is ——% less than 54

31. ——% more than 9 is 12

32. 19 is 5% less than ——

AN OLD proverb says that "All work and no play makes Jack a dull boy." Governments realize that **play is an important element in the health and happiness of the people,** and so they provide public playgrounds where children, and older people too, can play under pleasant and safe conditions.

1. In one of our large cities there are 54 public playgrounds which have a total area of 359.6 A. This is an average of how many acres per playground?

2. In Ex. 1, the population of the city is 780,000. How many square feet (1 A. = 43,560 sq. ft.) of playground space are there per person?

3. At two popular toboggan slides located in a city playground, the attendance for 5 da. was 27,300 and 12,500. What was the average attendance per day for each slide? The smaller attendance was what per cent of the larger?

4. In a city which last year spent $14,600,000 for schools and $1,290,000 for its public library, the expense for playgrounds was $219,000. The expense of the playgrounds was what per cent of each of the other expenses?

5. At 33 of the largest playgrounds in a city the total attendance during a recent year was 8,452,449. What was the average attendance at each playground?

6. A city built a municipal athletic field which was 1000 ft. long and 300 ft. wide. To the nearest 0.1 A. (see Ex. 2), how many acres were there in the field?

7. The football field at a city playground is 120 yd. long and 160 ft. wide, and the soccer field is 100 yd. long and 60 yd. wide. Which has the larger area, and how much larger is it?

GOOD sportsmanship is encouraged by all nations. Every four years the nations of the world send teams to the Olympic Games, which take their name from the contests held in ancient Greece where Mount Olympus is located.

1. The ancient Greeks had a 200-meter race, and one of the races in the modern games is 10,000 meters. Taking the meter as $3\frac{1}{4}$ ft., find the length in feet of each race.

2. In a recent year the time of the winner of the 800-meter race in the Olympic Games was 1 min. 51.8 sec. What was his average speed in feet per second?

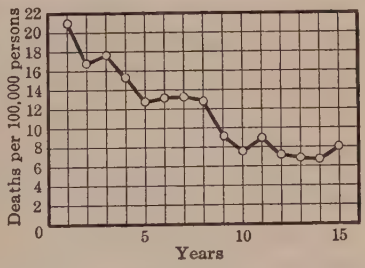
3. The time of the winner of the 200-meter dash was 21.8 sec. What was his average speed in feet per second?

4. The winner of the discus throw for women threw the discus 129 ft. 11.9 in., while the winner of this event for men threw it 155 ft. 2.8 in. The man's throw was what per cent longer than the woman's?

NATIONAL, state, and local governments spend large sums of money each year in public-health work. Such work includes regular inspections of water and food supplies, the maintenance of clinics and hospitals for discovering and treating diseases, and similar activities.

1. In a year in which the total expenses were $512,500,000, New York City spent about $46,083,000 on public-health work. What per cent of the total, to the nearest 0.1%, did the city spend for this purpose?

2. The inspection of water and milk supplies is important in preventing the spread of typhoid fever. This graph shows the death rate in the United States from typhoid fever during a period of 15 yr. How many deaths were there for each 100,000 persons the first year? the fifteenth year?



3. In Ex. 2, the number of deaths the fifteenth year was what per cent of the number the first year?

4. In Ex. 2, in what year was the death rate the lowest?

5. In the same years as in Ex. 2, the country's death rate per 100,000 from diphtheria was as follows: 19, 18, 19, 18, 16, 15, 17, 14, 15, 15, 18, 15, 12, 9, 8. Draw a broken-line graph to show these facts.

6. Of the 7548 samples of milk tested in one large city in a recent year, 338 were found to be below standard. What per cent of the samples were below standard?

BESIDES safeguarding the purity of our food by laws and by inspections, the national government makes a study of other food problems and often issues bulletins which give helpful information about diet and health.

For good health, a person's diet should include foods that contain sufficient **proteins to build and repair the body tissues,** and sufficient **carbohydrates and fats to furnish heat and energy.** Meat, eggs, fish, and cheese supply proteins; vegetables, fruit, cereals, and sugar supply carbohydrates; and butter, cream, oils, and certain meats supply fats. Many foods supply two or more of these elements. Milk, for example, contains all three in well-balanced proportions.

Since food must furnish heat and energy, food values are often measured in calories. **A calorie is the amount of heat needed to raise the temperature of 1 pt. of water about 4° F.**

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1. The number of calories that a person needs per day depends upon his age, his weight, and the kind of work he does. One authority recommends 40 calories per pound of weight for children. How many calories per day does a boy weighing 85 lb. need? How many do you need?

2. For a man who is not doing muscular work, a diet furnishing about 3000 calories per day is recommended. This is what per cent of the amount needed by the boy in Ex. 1?

3. Food should be selected not alone for its value in calories, but also so as to provide a proper balance between proteins, carbohydrates, and fats. A diet recommended for children provides 15.8% proteins, 69.3% carbohydrates, and 14.9% fats. How many calories of each would there be in a diet that furnishes 3500 calories per day?

4. Beef (sirloin) furnishes 975 calories to the pound, while rice furnishes 1630 calories. Considering calories only (see Ex. 3), rice has what per cent greater food value than beef?

5. White potatoes furnish 295 calories to the pound. Potatoes have what per cent less food value than beef (Ex. 4)?

6. Butter furnishes 3410 calories per pound. How much butter, to the nearest ounce, would you have to add to a pound of potatoes (Ex. 5) in order to have them equal in food value a pound of beef (Ex. 4)?

7. Of the 340 calories furnished by a pint of milk, 68 are proteins, 96 are carbohydrates, and 176 are fats. Milk contains what per cent of each of these food elements?

8. One authority states that many adults eat each day food enough to furnish 20 calories per pound of weight, whereas 13.5 calories per pound would give better health. By what per cent could such a person cut down the amount that he eats?

9. In a diet which furnishes 900 calories at breakfast, 920 at lunch, and 1695 at dinner, what is the total number of calories provided during the day? This diet furnishes what per cent more calories per day than are needed by a woman who requires 2400 calories per day?

10. Mrs. Holmes plans the meals for her family, which consists of 4 persons, so as to get the best food value for her money. In a week in which she spends $15.40 for food, what is the average cost per person per meal?

11. During the 21 school days in a recent month a school lunch room served an average of 280 lunches per day. The total receipts that month were $846.60. What was the average price that was paid for a lunch?

1. There are 568,354,000 A. of forest land in the United States, of which 389,500,000 A. are protected by regular patrols. What per cent of the forest land is unprotected?

2. In a recent year the total amount of life insurance in force in the United States was $87,000,000,000, while the amount in force in Canada was $4,300,000,000. Taking the population of the United States as 125,000,000 and that of Canada as 9,000,000, find the amount of insurance per person in each country.

3. In a recent year there were 7115 sailing vessels, totaling about 2,336,000 T., and 18,270 steam vessels, totaling 14,347,000 T., sailing under the American flag. To the nearest ton, what was the average tonnage of each type of vessel?

4. In Ex. 3, the number of sailing vessels was what per cent of the number of steam vessels?

5. There are about 30,000,000 telephones in the world. Taking the world's population as 1,895,000,000, this is one telephone to about how many people?

See how quickly you can do these examples:

6. $3452 + 1679$
7. $8135 - 5647$
8. 0.085×1679
9. 932×458
10. $1728 - 959$
11. $\$334.88 \div 5824$
12. $13{,}956 - 4387$
13. $485\frac{1}{2} \times 328$
14. $0.04\frac{1}{2} \times 6 \times 340$
15. $\$139.26 \div 844$
16. $12\frac{1}{2} \times 8\frac{1}{4} \times 25\frac{1}{8}$
17. $56{,}372 + 29{,}403$

See how quickly you can state the answers:

1. $\begin{array}{r} 57 \\ +32 \\ \hline \end{array}$	2. $\begin{array}{r} 68 \\ -43 \\ \hline \end{array}$	3. $\begin{array}{r} 72 \\ +19 \\ \hline \end{array}$	4. $\begin{array}{r} 41 \\ \times 5 \\ \hline \end{array}$	5. $\begin{array}{r} 32 \\ \times 4 \\ \hline \end{array}$
6. $2\overline{)24}$	7. $3\overline{)72}$	8. $5\overline{)95}$	9. $8\overline{)96}$	10. $9\overline{)108}$

Give these per cents orally:

11. 25% of 120
12. $33\frac{1}{3}$% of 156
13. 25% of 160
14. $12\frac{1}{2}$% of 320
15. 5% of 120
16. 20% of 75

Tell which of these statements are incorrect, and give the correct answers:

17. $\frac{1}{2}+\frac{3}{4}=\frac{4}{6}$
18. $\frac{3}{4}-\frac{1}{2}=\frac{2}{2}$
19. $\frac{1}{4}+\frac{3}{4}=1$
20. $\frac{1}{4}\times\frac{3}{4}=\frac{3}{4}$
21. $\frac{2}{3}\times\frac{3}{4}=\frac{1}{2}$
22. $\frac{3}{4}\times\frac{2}{3}=\frac{5}{7}$
23. $\frac{1}{2}\div\frac{1}{2}=\frac{1}{2}$
24. $\frac{3}{4}\div\frac{1}{2}=1\frac{1}{2}$
25. $\frac{1}{4}\div\frac{5}{8}=10$

Read and complete these statements:

26. 2 ft. = —— in.
27. 2 in. = —— ft.
28. 15 min. = —— hr.
29. $\frac{1}{2}$ yd. = —— in.
30. 9 ft. = —— yd.
31. 72 in. = —— yd.

Tell the numbers that belong in the blank spaces:

32. 2% of 25 is ——
33. 2 is ——% of 8
34. ——% of 48 is 24
35. 20% of —— is 12
36. 60% of 60 is ——
37. 50% is —— of 100%
38. 25% is 50% of ——%
39. ——% is 50% of $66\frac{2}{3}$%
40. 25 is ——% more than 20
41. 20 is ——% less than 25

See how quickly you can do these examples:

1.	2.	3.	4.	5.
8945	1575	$89.16	165.3	3.275
307	863	5.08	10.2	8.062
2056	8055	7.14	108.5	1.207
1945	296	12.88	99.8	.990
565	4860	5.97	256.4	5.560
1086	9010	16.27	6.0	.305
+32	+207	+24.98	+238.7	+4.650

6.	7.	8.	9.	10.
4275	9872	$75.80	1.875	628.5
−398	−7596	−69.75	−.986	−439.6

Multiply or divide as indicated:

11. 48×296
12. $15\frac{1}{2} \times 620$
13. $14{,}043 \div 186$
14. $1106.7 \div 23.8$
15. $32\frac{1}{8} \times 16\frac{1}{4}$
16. $5\frac{1}{3} \times 24.3$
17. $12\frac{1}{2} \times 16.8$
18. 24.2×5.75
19. $12\frac{3}{4} \div \frac{3}{4}$
20. $16\frac{2}{3} \div 2\frac{1}{2}$
21. $31{,}330 \div 65$
22. $136.8 \div 42.75$

Find the missing numbers:

23. $162 \times 354 =$ ——
24. $10{,}494 =$ —— $\times 53$
25. $0.06 \times \$$—— $= \$45$
26. —— $\times 640 = 512$
27. $\$6 \div \$18 =$ ——%
28. 98% of 40 is ——
29. $5 is ——% of $3
30. —— $\times \$650 = \$48.75$
31. $16\frac{1}{2} + 25\frac{1}{8} + 7\frac{3}{4} =$ ——
32. $24\frac{1}{2} +$ —— $+ 12\frac{1}{8} = 41\frac{7}{8}$
33. $0.05\frac{1}{2} \times \$302 = \$$——
34. $\$2750 \div 0.05\frac{1}{2} = \$$——
35. $14 \times 12\frac{1}{4} \times 8\frac{1}{2} =$ ——
36. 6 ft. is ——% of 20 ft.

Following a Plan in Solving Problems

FOR many of the problems that you had to solve in your previous work, the book gave a model solution. In this section, which presents problems about miscellaneous subjects, no such help will be given. As you have already learned, **you should always have a definite plan for solving a problem.**

In making this plan, first **read the problem carefully** and then ask yourself these four questions:

1. **What am I to find?**
2. **What numbers shall I use?**
3. **Shall I add, subtract, multiply, or divide?**
4. **About how large will the answer be?**

For example, suppose that you have this problem: Mrs. James bought $4\frac{1}{2}$ yd. of gingham that was marked 40¢ a yard at a sale at which she was allowed a discount of 15%. How much did she save?

You can think, "I must find the amount of the discount, but to do this I must first find the amount of the sale. I can do this by taking the 40¢ (or \$0.40) and the $4\frac{1}{2}$ and multiplying. I can then find the amount of the discount by taking 15% of the amount of the sale; that is, I must multiply the amount of the sale by 0.15."

For the fourth question you can think, "Since $4\frac{1}{2} \times \$0.40$ is a little less than $5 \times \$0.40$, or \$2, and since $0.15 \times \$2$ is \$0.30, my answer will be a little less than 30¢." This is, of course, only a rough check, but an estimate like this **will often save you from giving an absurd answer,** such as might come from an error in placing a decimal point.

Then solve the problem and check the answer.

Planning How to Solve a Problem

YOU have probably heard of the old proverb, **"Look before you leap."** In solving problems in arithmetic, this might well read **"Plan before you solve."**

After reading each problem, ask yourself the four questions on page 411. Then solve the problem and check the answer:

1. The amount of starch in potatoes averages 17% of the weight. How much starch is there in 60 lb. of potatoes?

2. What is the perimeter (the distance around) of a square that is 6 in. on a side?

3. At the rate of 19 mills on $1, find the amount of the tax paid on a piece of property that is assessed at $7500.

4. Some real-estate agents charge a commission of 4%. What will be the commission in selling a house for $8000?

5. In 6 wk. the weight of Jim's pig increased from 150 lb. to 202.5 lb. What was the average daily gain?

6. When the duty on furniture is $33\frac{1}{3}\%$ of the value, what is the total duty on a shipment valued at $13,500?

7. In a corn-husking contest, the winner husked 26.5 bu. of corn in 80 min. This was how many bushels per hour?

8. What is the interest on $250 for 9 mo. at $4\frac{1}{2}\%$?

9. What is the average speed per hour of a car that travels 73.8 mi. in 2 hr. 15 min.?

10. In a recent year Texas, which has an area of about 265,900 sq. mi., had 16,250 mi. of railroads, which was the largest mileage of any state. Illinois, which has an area of about 56,000 sq. mi., came next with 12,000 mi. Find the number of miles of railroad per square mile in each state.

THE class made up some problems without numbers in order to get practice in telling how to solve problems. Here are some of the problems that they made up.

Tell how you would solve each of these problems if the numbers that belong in the blank spaces were given:

1. *Joe's problem:* The length of this room is —— ft. and the width is —— ft. The width is what per cent of the length?

2. *Kate's problem:* I am thinking of a number that is ——% of ——. What is the number?

3. *Ned's problem:* My father bought me a pair of skates that were marked $——. He got them at a sale at which a discount of ——% was given. How much did the skates cost?

4. *Betty's problem:* At the basketball game last Saturday I made —— of the —— points that our team scored. What per cent of the points did I score?

5. *Tom's problem:* I paid ——¢ for oranges and ——¢ for bananas. How much change did I get from $——?

6. *Alice's problem:* Our car will go —— mi. for each gallon of gasoline. Last Sunday we drove —— mi. At ——¢ per gallon, how much did the gasoline cost for the trip?

7. *Ted's problem:* I get ——¢ for each paper that I deliver. Last week I delivered —— papers each week day and —— on Sunday. How much did I earn?

8. *Mary's problem:* My father is in the hardware business. He ordered —— doz. hammers which were listed at $—— per dozen. He was allowed a discount of ——%. How much did the hammers cost apiece?

1. White eggs have no more food value than brown eggs, but in some places they sell better. When white eggs are selling at 64¢ a dozen and brown eggs at 60¢, what per cent of the higher price can Mrs. Webb save by buying brown eggs?

2. Mrs. Arnold bought a luncheon set that had been marked down from $5 to $3.75. What per cent had the set been marked down?

3. When sugar costs $5\frac{1}{2}$¢ a pound in bulk and 14¢ for a package weighing 2 lb., how much can be saved by buying 20 lb. of sugar in bulk?

4. The saving in time and health by buying things that make housework easier is often worth more than the cost. Mrs. White bought at a discount of 20% a vacuum cleaner that had been marked $50. How much did she pay for it?

5. Some cheap cuts of beef have the same food value as the more expensive ones, and by proper cooking they can be made to taste just as good. When a chuck roast of beef costs 26¢ a pound and a sirloin roast costs 52¢, what per cent more must Mrs. Ball pay for the sirloin roast?

6. Mrs. Shaw found her favorite brand of soap marked "3 cakes for 19¢" at one store and "4 cakes for 25¢" at another. How much could she save in buying 1 doz. cakes at the cheaper price?

7. Mrs. Reed had been buying olive oil in $\frac{1}{2}$-pint bottles at 40¢ until she found that she could buy 1-quart cans at $1. How much can she save on each quart used?

8. Mrs. West can buy ginger ale at $1.95 per dozen bottles or at $3.75 for a case of 24 bottles. On 6 doz. bottles, how much can she save by buying by the case?

9. One night Mr. Dale forgot to turn off the electric light in the cellar, and it burned for 12 hr. At 0.6¢ per hour, what was the cost of the electricity wasted?

10. Mrs. Hill uses her electric iron an average of 18 hr. a month. She estimates that it used to take 150 lb. of coal a month to heat the irons before she had electricity. At $12 per ton for the coal and $5\frac{1}{2}$¢ per hour for the electricity, which method is the cheaper? How much cheaper per month is it?

11. Mrs. Brooks heats her irons on a gas stove. She estimates that for 18 hr. per month it takes 600 cu. ft. of gas. At $1.20 per 1000 cu. ft., how much more or less per month does it cost her than Mrs. Hill (see Ex. 10)?

12. Mrs. Kent pays 25¢ for ice every 3 da. Mrs. Wood has an electric refrigerator which uses an average of $2.75 worth of electricity per month. Which refrigerator costs more per month (30 da.), and how much more does it cost?

13. Billy Lane forgot to turn off the bathroom faucet. His father said that it had wasted 90 gal. of water an hour for 4 hr. At $7\frac{1}{2}$ gal. to the cubic foot, how many cubic feet of water did Billy waste?

14. In Ex. 13, if the water rate is 15¢ per 100 cu. ft., what was the cost of Billy's carelessness?

15. By covering his furnace and pipes with asbestos, Mr. Jay expects to increase the heating power 20%. If he used 8 T. of coal last year at $14 per ton, how much coal should he need this year? How much money should this save?

16. In Ex. 15, the cost of the furnace and pipe covering was $28.50. Should he gain or lose the first year? How much? Should he gain or lose the second year? How much?

1. A girl who saves \$2.50 per week from a weekly salary of \$28 is saving what per cent of her income?

2. Each month Mr. and Mrs. Downing plan to put 10% of the family income, which is \$3000 a year, into the savings bank. Last month they were able to save only \$17.50. How much must they save this month in order to catch up?

3. Mrs. Carter has \$78,000 invested in stocks and bonds which yield an average of $5\frac{3}{4}\%$ a year on the amount invested. How large a yearly income do her investments give her?

4. Mr. White wishes to have an income of \$4500 a year when he retires from business. How large a sum will he have to invest at $5\frac{1}{2}\%$ in order to furnish this income?

5. At 5%, compounded every 6 mo., regular deposits of \$10 per month will amount to \$682.01 in 5 yr. What is the total amount deposited during the 5 yr.? How much interest does the money earn?

6. At 8%, compounded every 6 mo., the amount in Ex. 5 would be \$737.18 instead of \$682.01. How much more interest will the money earn at 8% than at 5%?

7. If you want to save \$1000 in 2 yr., you can do so if you will deposit \$9.12 per week for 52 wk. each year in a savings bank that pays interest at $4\frac{1}{2}\%$ a year, compounded every 6 mo. What will be the total amount that you will have to deposit? How much interest will your money earn?

8. At 5%, simple interest, it takes 20 yr. for an investment to double itself, while at 5%, compounded every 6 mo., it takes only 14.04 yr. To the nearest 0.1%, in what per cent less time will money double itself at compound interest at 5% than at simple interest at 5%?

Write the numbers 1 to 20 on your paper, and after each number put a check mark (✓) if the corresponding statement below is correct and a zero (0) if it is not:

1. $\frac{1}{2} \times 15 = 7\frac{1}{2}$
2. $240 - 15 = 125$
3. $3\frac{3}{4} \times 8 = 26$
4. $176 \div 8 = 22$
5. $600 - 240 = 460$
6. $12\frac{1}{2}\%$ of $108 = 9$
7. $85 \div 15 = 5\frac{2}{3}$
8. $\frac{3}{4}$ of $240 = 180$
9. $8 \times 121 = 968$
10. $0.05 \times 140 = 70$
11. $720 \div 240 = 3$
12. $66\frac{2}{3}\%$ of $660 = 44$
13. $62.8 + 29.4 = 92.2$
14. $225 \div 15 = 15$
15. $3\frac{1}{2} \times 250 = 785$
16. 90% of $900 = 810$
17. $106.2 - 90.7 = 5.5$
18. $1.25 \times 320 = 360$
19. $0.003 \times 1.05 = 0.3150$
20. $3.825 \div 0.05 = 0.765$

See how quickly you can give the answers:

21. $14 + 8$
22. $19 - 8$
23. 7×19
24. $2\frac{1}{2} \div \frac{1}{4}$
25. $3\frac{1}{2} \times 12$
26. 19×37
27. $17 \div 51$
28. 15×15
29. $38 - 29$
30. $21\frac{1}{4} \div 5$
31. $23\frac{1}{2} - 8\frac{3}{4}$
32. $18\frac{3}{4} + 2\frac{1}{8}$
33. $10.5 \div 0.3$
34. $12\frac{1}{2} \times 25$
35. $1.8 \div 0.09$
36. 3.5×6.2
37. $0.05 \div 0.5$
38. 16×2.7
39. $137 - 98$
40. $25.5 \div 0.05$
41. $239 - 113$
42. $426 + 107$
43. $384 \div 12$
44. $92\frac{1}{2} - 86\frac{1}{8}$
45. $22.5 - 19.8$
46. $12.05 + 8.61$
47. $6\frac{1}{2} \times 6\frac{1}{2}$
48. $28.5 \div 1.5$
49. $18\frac{3}{4} - 9\frac{1}{8}$
50. $4.387 - 1.908$

CONCRETE, which is extensively used today in all kinds of construction where strength and durability are important, is made by mixing **cement, sand, and crushed rock** in varying proportions with water. The picture shows a concrete mixer at work.

1. A 1-2-3 mixture of concrete contains 1 part cement, 2 parts sand, and 3 parts crushed rock. What is the ratio of cement to sand? of sand to the mixture?

2. To make 1 cu. yd. of 1-2-3 concrete it takes approximately $1\frac{3}{4}$ bbl. of cement, $\frac{1}{2}$ cu. yd. of sand, and $\frac{3}{4}$ cu. yd. of crushed rock. How much of each of these materials will be needed for a job requiring 1240 cu. yd. of concrete?

3. In Ex. 2, it takes more than 1 cu. yd. of materials to make 1 cu. yd. of concrete because the sand and cement fill in around the pieces of crushed rock. Allowing 4 cu. ft. to the barrel, how much more than 1 cu. yd. of materials does it take?

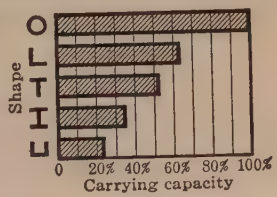
4. How much 1-2-3 concrete will 35 bbl. of cement make? How much each of sand and gravel must be added?

5. How many cubic yards of concrete will be needed for a walk that is to be 180 ft. long, 6 ft. wide, and 4 in. thick? If a 1-2-3 mixture is used, how much each of cement, sand, and crushed rock will it take?

6. To make 1 cu. yd. of 1-3-5 concrete it takes approximately $1\frac{1}{4}$ bbl. of cement, $\frac{1}{2}$ cu. yd. of sand, and $\frac{7}{8}$ cu. yd. of crushed rock. How much of each of these will be needed for a job requiring 2000 cu. yd. of concrete?

7. In making concrete columns, iron or steel rods are often embedded in the concrete to give the columns greater strength. Allowing 10% of the volume for the space occupied by the reenforcing rods, how many cubic yards of concrete will it take for 40 columns, each $1\frac{1}{2}$ ft. square and 12 ft. high?

8. The shape of a column has much to do with the weight that it can support with safety. This graph shows the relative strengths of steel columns, the hollow cylindric column being taken as the standard (100%). The carrying capacity of each of the other shapes is approximately what per cent of that of the hollow cylindric column?

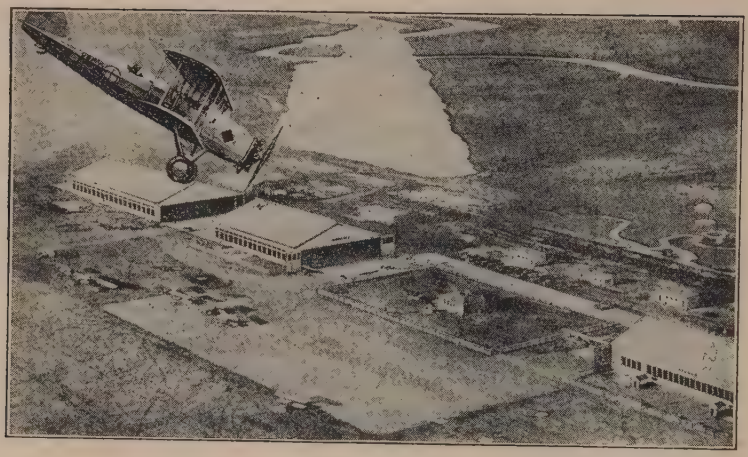


9. In Ex. 8, what is the ratio of the carrying capacity of the U-column to that of the L-column? of the T-column?

10. To make 1 cu. yd. of 1-2-4 concrete it takes approximately 1.6 bbl. of cement, 0.44 cu. yd. of sand, and 0.88 cu. yd. of crushed rock. How much of each of these materials will be needed per mile in surfacing a road 30 ft. wide with a layer of concrete 9 in. thick?

11. A wall 300 ft. long, 12 ft. high, and 2 ft. thick is to be built of concrete reenforced with iron rods. Deducting 10% of the total volume for the volume of the reenforcing material, how many cubic yards of concrete will be needed?

12. In Ex. 11, if a 1-3-5 mixture is used (Ex. 6) how much each of sand, cement, and crushed rock will be needed?



1. A landing field for passenger-carrying planes should be at least 1500 ft. square. How many square feet are there in a field that is exactly this size?

2. There are 43,560 sq. ft. in 1 A. In Ex. 1, how many acres, to the nearest 0.1 A., are there in the field?

3. At $1850 per acre, find the cost of a landing field that is 2200 ft. long and 1800 ft. wide.

4. The runways from which the planes take off are often made of concrete. Find the number of square yards of concrete in a runway 720 ft. long and 20 ft. wide.

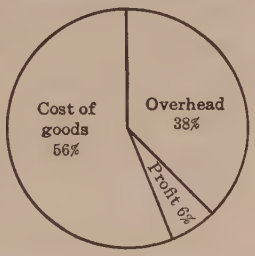
5. Buildings in which airplanes are kept are called hangars. Find the number of square feet of floor space in a hangar that is 105 ft. long and 100 ft. wide.

6. One year the total number of passengers carried from one field was 1286. The next year the total was 2874. To the nearest 0.1%, what was the per cent of increase?

1. A dealer sold for \$20 an article for which he paid \$12. To cover the overhead (running expenses) of his store, he made an allowance of \$6 on this sale. How much profit did the dealer make on the sale?

2. In Ex. 1, the profit was what per cent of the selling price of the article?

3. In making a study of his last year's business, a furniture dealer expressed his profit and the amounts that he spent for goods and for overhead as per cents of his total sales. The results are shown in the accompanying graph. On each \$100 worth of business (sales), how much went to pay for goods? How much was needed to cover the overhead? How much was profit?



4. In Ex. 3, the cost of the goods last year was what per cent of the selling price?

5. If, in Ex. 4, the dealer takes 38% of the selling price as his standard allowance for overhead, what selling price should he place on a table costing \$56 in order to make a profit of 6% of the selling price?

6. In Ex. 5, what selling price should he place on a set of furniture for which he pays \$210?

7. A dealer sold for \$4.50 an article for which he paid \$3.60. If his overhead averages $33\frac{1}{3}\%$ of his sales, did he gain or lose on the sale of the article? How much did he gain or lose? The profit or loss was what per cent of the selling price?

8. Profit is sometimes figured on the cost of goods instead of on the selling price. If a dealer makes \$2.04 on an article costing \$24, what per cent of profit does he make on the cost?

1. A department store borrowed \$45,000 for 6 mo. in order to make some extensive alterations in the store. At $5\frac{1}{2}\%$, how much was the interest on the loan?

2. A store paid the 35 salesgirls in one department a total of \$268.50 in commissions one week. To the nearest cent, what was the average commission paid?

3. On an order for goods amounting to \$1282.50 at list prices, a dealer was allowed a trade discount of 40% and an extra discount of 2% if he paid for the goods within 10 da. If he did so, how much did the goods cost him?

4. By taking advantage of a discount of 2% for cash, a dealer saved \$45.31 on one lot of goods. What was the amount of the bill before the cash discount was deducted?

5. In a year in which his total sales were \$112,500, a retail dealer's overhead (running expenses) was \$31,500. The overhead was what per cent of the total sales?

6. In Ex. 5, how much should the dealer allow for overhead on an article which he sells for \$17.50?

7. In Ex. 5, the dealer's profit was $5\frac{1}{2}\%$ of the total sales. How much profit did he make that year?

8. A specialty shop bought some dresses at \$15 apiece and sold them at \$25. If the overhead averaged 30% of the selling price, how much profit did the shop make on each dress?

9. In Ex. 8, what was the per cent of profit on the selling price? on the cost?

10. A sporting-goods dealer bought some hammocks at \$16 apiece. If his overhead averages 28% of the selling price, at what price should he sell the hammocks in order to make a profit of 8% of the selling price?

1. In a year in which his total sales were \$425,850, a manufacturer's profit was 4.8% of this amount. How much profit did he make?

2. In determining the manufacturing cost of an article, a manufacturer must know how much it costs for materials, labor, and factory overhead. What is the manufacturing cost of an article for which the material cost was \$12.80, the labor cost was \$14.40, and the factory overhead was \$4.80?

3. In Ex. 2, what per cent of the manufacturing cost was spent for materials? for labor? for factory overhead?

4. On an article which cost \$24.50 to manufacture, the cost of materials was 46% of the manufacturing cost, the labor cost was 38%, and the factory overhead was 16%. What amount was spent for each of these three items?

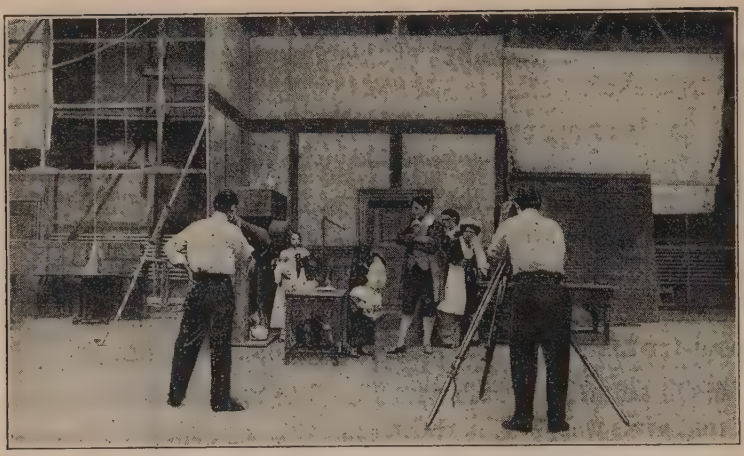
5. A factory sells at \$6 each an article that costs \$4.50 to manufacture. If the expenses of selling average 90¢ per article, how much profit is made on each one?

6. In Ex. 5, the profit is what per cent of the selling price? of the manufacturing cost?

7. A shoe manufacturer sells a certain style of shoe to retailers at \$5.25 a pair. If the selling expenses average 14% of the selling price and the profit is 10% of the selling price, what is the manufacturing cost per pair?

8. In determining the selling price of an article that costs \$12.60 to manufacture, a manufacturer allows 15% of the selling price to cover his selling expenses. What price must he get for it in order to make a profit of 10% of the selling price?

9. At what price should the manufacturer in Ex. 8 list the article so that he can allow a retailer a discount of 40%?



1. In a 10-reel picture which averaged 70 scenes per reel, 25% of the scenes were photographed twice, 10% were photographed 3 times, and 1% were photographed 5 times. How many scenes were photographed twice? 3 times? 5 times?

2. The 9500 ft. of film used in making a recent picture was finally cut to 5 reels of 1000 ft. each. The length of the finished picture was what per cent of the original length?

3. The United States, which makes 85% of the world's moving pictures, uses about 1,250,000,000 ft. of film a year. How much film is used yearly in the world?

4. In a recent year there were 20,500 moving-picture theaters in the United States and 1020 in Canada. Canada had what per cent of the number in the United States?

5. In one theater last year the receipts averaged $7600 per week, and the profit was 2.3% of this amount. How much profit did the theater make in the 52 wk.?

1. The Roosevelt Dam in Arizona forms a lake which covers 25.5 sq. mi. How many acres (1 sq. mi. = 640 A.) is this?

2. A cake of chocolate, which is 95% carbohydrates, furnishes 250 calories. How many calories of carbohydrates does such a cake furnish?

3. Dry clay will absorb 40% of its own weight in water. How much water will 60 lb. of dry clay absorb?

4. In a recent gale, a fishing fleet lost 31,000 nets having a total value of $750,000. How much, on the average, was each net worth?

5. In pasteurizing milk in order to make it safer for people to use, the milk is heated to a temperature of 157°. This is what per cent less than the boiling point of water, 212°?

6. Last year Mr. Brown raised an average of 32.4 bu. of corn to the acre, but if he had kept his fields free of weeds he could have increased this yield 10%. How many more bushels could he have got from 20 A.?

7. In a year when the local property-tax rate is $23.40 per $1000, how much does a property owner pay in taxes on a house that is assessed at $7500?

8. One year the season's catch of a fishing vessel totaled 4,903,000 lb., valued at $174,000. What was the average value per pound?

9. In Ex. 8, the 13 members of the crew received $4000 each for the season's work. The total paid the crew was what per cent of the value of the vessel's catch?

10. A builder bought 8 kegs of nails, each weighing 50 lb., at $4\frac{3}{4}¢$ per pound. If he was allowed a discount of 20% and an extra discount of 2% for cash, how much did the nails cost?

THIS page will help you to find out how well you can solve problems. After you have finished your work, mark your paper according to the scale shown in the table at the right.

Correct	Mark
9 or 10	Excellent
7 or 8	Good
5 or 6	Fair
0 to 4	Poor

1. Mr. Adams packs fancy apples in baskets that hold 2 pk. each. How many baskets will he need for 150 bu. of apples?

2. Mr. Adams made a profit of $10 on 60 bu. of apples. At the same rate, how much would he make on the 150 bu.?

3. The long ton of 2240 lb. is used in mining. This is what per cent greater than the ordinary ton of 2000 lb.?

4. At 56 lb. to the bushel, how many bushels are there in a load of corn that weighs $2\frac{1}{4}$ T.?

5. If you own some $3\frac{3}{4}\%$ government bonds with a face value of $7000, how much interest will you get every 6 mo.?

6. Last month the Reeds used 3800 cu. ft. of gas. At $1.40 per 1000 cu. ft., how much was their gas bill?

7. On an article which sells for $18 a dealer makes a profit of $1.44. The profit is what per cent of the selling price?

8. A dealer saved $16.80 by paying a bill in time to get a cash discount of 2%. What was the amount of the bill?

9. At what per cent of interest must $850 be invested in order to give an income of $42.50 per year?

10. A man bought a corn-popping machine for $400 by paying $220 down. If he has to pay interest at 7% on the balance, to how much will this interest amount in 6 mo.?

CHAPTER EIGHT

MEASUREMENTS AND SCIENCE

I. MEASUREMENTS

Accuracy of Measurement

FROM previous work with measurements, you know that in any kind of measurement the degree of accuracy to be expected depends both upon the accuracy of the instruments and the care with which they are used.

All measurements are only approximate.

No result can be more accurate than the least accurate of the measurements upon which it is based.

In measuring a room with a steel tape, you can generally measure **to the nearest $\frac{1}{8}$ in.** In giving the distance from New York to Chicago, it would ordinarily be sufficient to give it **to the nearest 1 mi.**, but in giving the distance to the sun it would not be sensible to try to give it closer than **to the nearest 100 mi.** or even **to the nearest 1000 mi.**

When there is more than one dimension, as in a house lot or a room, **both dimensions are understood to be of the same degree of accuracy.** If you can measure the length to the nearest 0.01 ft., it is not sensible to think that the width can be measured only to the nearest foot. Thus, a lot that is 166.75 ft. long and 85 ft. wide means one that is 166.75 ft. long and 85.00 ft. wide, each to the nearest 0.01 ft.

1. Jim and Ted measured the schoolroom and said that it was 33 ft. $5\frac{7}{8}$ in. long and 24 ft. $3\frac{1}{8}$ in. wide. What fractional part of a foot is $\frac{1}{8}$ in.? If you wished to give these dimensions decimally, would you give them to the nearest 0.1 ft. or to the nearest 0.01 ft.? Give reasons for your answer.

2. Tell what degree of accuracy you would consider sensible in measuring the distance from your house to the school; the distance from New York to Paris; the height of a mountain; the weight of this book; your own weight; the weight of a locomotive; the speed of an automobile. Do not expect all the answers to be the same.

3. Draw a line $5\frac{3}{8}$ in. long with a ruler. From one end mark off $1\frac{1}{16}$ in. and from the other end mark off $2\frac{5}{16}$ in. Then measure the middle part, and check your measurement by adding this length to the sum of the two lengths marked off.

4. Tom weighed himself on some scales which gave his weight, to the nearest $\frac{1}{4}$ lb., as $76\frac{3}{4}$ lb. How many ounces more than this might it be? How many less?

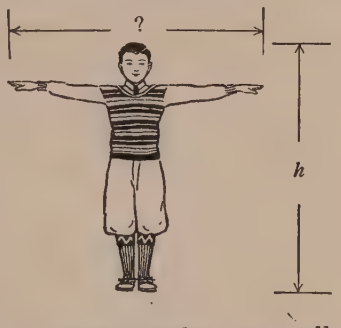
5. Tom measured the thickness of the first 200 pages in this book to the nearest $\frac{1}{16}$ in. He then divided this by 100 to find the thickness of each leaf. He gave the answer to the nearest 0.001 in. Was this an accurate way of doing it, or did it give only a rough approximation? Try it with the first 200 pages. Then try it with the first 210 pages and divide by 105.

6. Working in pairs, measure the length and width of the schoolroom floor to the nearest $\frac{1}{8}$ in. Compare the results obtained by the different groups.

7. In Ex. 6, take the dimensions found by all the groups and find the average length and the average width. Why are these averages probably the best approximations?

1. Draw free-hand on the blackboard a line that you think is 6 in. long; 1 ft. long; 1 yd. long. Then measure to see how closely you estimated these lengths.

2. Do you know the distance between your fingertips when you stretch out your arms as shown in this picture? In most people, **it is approximately equal to their height.** Measure and see if this is true in your case.

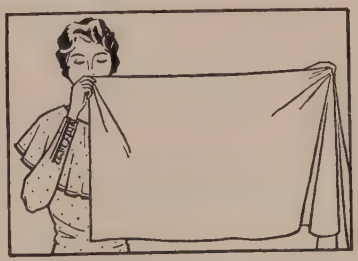


3. By measuring with outstretched arms, as in Ex. 2, estimate the length of the blackboard. Then check it with a yardstick.

4. Make several measurements of the distance that you walk in 25 or 50 steps, and find the length of your average step.

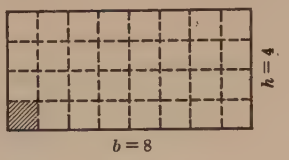
5. By pacing, estimate the length of the school building, and then measure to see how close your estimate was.

6. This picture shows how some people estimate the number of yards in a piece of cloth. In grown people, **the distance from the tip of the nose to the tip of the middle finger when the arm is outstretched is about 1 yd.** Using a piece of string, measure and find what this distance is in your case.



7. Measure off outdoors a distance of 100 yd. and study it so as to see how long 100 yd. is. Then try estimating in yards how far it is to each of several objects that are some distance away. If possible, check by measuring.

THIS picture shows a rectangle in which the length (or base) is 8 ft. and the width (or height) is 4 ft. The familiar rule for finding the area is



Area = base × height.

A more convenient way of remembering this rule is the formula

$$A = bh,$$

in which, as you will recall, omitting the sign between b and h means that the numbers which they represent are to be multiplied.

Study these two examples. The first one shows how to find the area in the above case, and the second in a case where the dimensions of the rectangle are given as 8.2 in. and 4.6 in.

(1) $A = bh$	(2) $A = bh$
$= 8 \times 4 = 32$	$= 8.2 \times 4.6 = 37.72$
32 sq. ft. *Ans.*	37.7 sq. in. *Ans.*

The answer in (2) is given to the nearest 0.1 sq. in. If the given dimensions **had been exact**, you could find the answer to the nearest 0.01 sq. in. **But no measurement is ever exact**, and so in cases where dimensions are given to the nearest 0.1, it will be enough if you find the area to the nearest 0.1; if given to the nearest 0.01, find the area to the nearest 0.01.

Find the areas of rectangles with the following dimensions:

1. 6 in., $3\frac{1}{2}$ in.
2. 3.5 ft., 2.5 ft.
3. 4 yd., 3.2 yd.
4. 2 mi., 1.5 mi.
5. 9.25 ft., 6.75 ft.
6. 7.28 in., 5.12 in.
7. $6\frac{1}{2}$ rd., $3\frac{1}{4}$ rd.
8. 8.2 rd., 4.3 rd.
9. $5\frac{1}{2}$ yd., $1\frac{3}{4}$ yd.

10. What is the area of the floor in a rectangular room that is 32 ft. 6 in. long and 24 ft. wide?

11. At \$3.50 per square yard, find the cost of a concrete walk 96 ft. long and 6 ft. wide.

12. What is the area of a lawn 50 ft. by 40 ft.? Allowing 1 lb. of grass seed to 400 sq. ft., how much seed will be required to seed the lawn?

13. Allowing 1 qt. of paint to 90 sq. ft. for the first coat and 1 qt. to 110 sq. ft. for the second, find the amount of paint needed for two coats on a floor 25 ft. by 20 ft.

14. Mary is going to buy a tablecloth that will hang down at least 12 in. all around a table that is 34 in. square. She finds that cloths of the kind she wants come only in 48-inch, 54-inch, and 60-inch squares. Which size should she buy?

15. At 30¢ per square foot, find the monthly rent of an office that is 40 ft. by 30 ft.

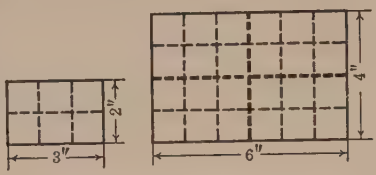
16. Find the number of square yards of concrete in the roadway of a bridge that is 20 ft. wide and $\frac{1}{2}$ mi. long.

17. It costs 4.4¢ per square foot to have a floor waxed by hand, and 2.4¢ per square foot to have it done by machine. How much could be saved by having a floor that is 20 ft. by 15 ft. waxed by machine?

18. John's camera takes pictures that are $1\frac{5}{8}$ in. wide and $2\frac{1}{2}$ in. high. He is making a loose-leaf album of heavy paper in which to keep his pictures. If he wants to put 9 pictures on a page, with $\frac{1}{2}$ in. between pictures and a 1-inch margin all around, what size of page should he use? What will be the area of such a page? Draw a diagram to show how he would place the pictures on each page.

1. Here are two rectangles which are both drawn to the same scale. Measure the picture, and find what scale was used.

2. Each side of the larger rectangle is how many times the corresponding side of the smaller? The area of the larger rectangle is how many times that of the smaller?

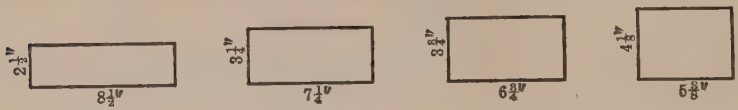


3. From Ex. 2, complete this statement: **Doubling each side of a rectangle multiplies the area by ——.**

4. Find the perimeter (the sum of the lengths of the sides) of each rectangle in Ex. 1.

5. Draw a rectangle of a convenient size, and then draw another with each side 3 times as long. The area of the larger rectangle is how many times that of the smaller?

6. Here are four rectangles which are drawn to the same scale. Which rectangle has the largest area? the smallest?



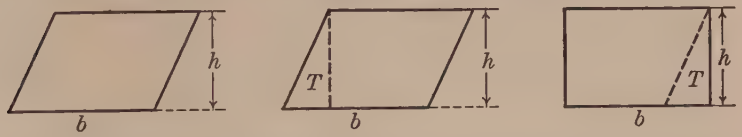
Draw a figure to illustrate each of the following statements and then complete the statement:

7. Multiplying each side of a square by 3 multiplies the perimeter by —— and the area by ——.

8. Multiplying both the base and the height of a rectangle by 3 multiplies the perimeter by —— and the area by ——.

9. Multiplying the base of a rectangle by 2 and the height by 3 multiplies the area by ——.

STUDY the three pictures below. They will help you to remember why the area of a parallelogram is the same as that of a rectangle which has the same base and the same height.



The rule for finding the area of a parallelogram may therefore be expressed either as

$$\text{Area} = \text{base} \times \text{height},$$

or as

$$A = bh.$$

---

1. A building lot was laid out in the form of a parallelogram with a base of 80 ft. and a height of 50 ft. At 18¢ per square foot, what price should be placed on this lot?

2. Which, if either, has the greater area, a parallelogram with a base of 16 in. and a height of 16 in., or a square that is 16 in. on a side? What is the area in each case?

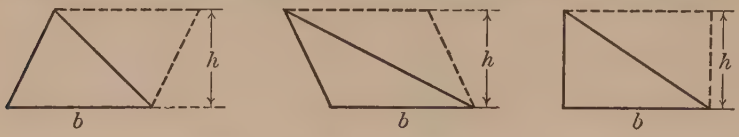
3. Find the area of a parallelogram in which the base is 8 in. and the height is $14\frac{1}{2}$ in.

Find the areas of parallelograms with these dimensions:

4. $b = 12$ ft., $h = 6\frac{1}{2}$ ft.
5. $b = 10\frac{1}{2}$ in., $h = 7\frac{1}{4}$ in.
6. $b = 6$ yd., $h = 3.5$ yd.
7. $b = 10$ rd., $h = 2$ rd.
8. $b = 50$ ft., $h = 35$ ft.
9. $b = 3$ ft., $h = 2$ ft. 3 in.
10. $b = 3.5$ mi., $h = 2.5$ mi.
11. $b = 90$ ft., $h = 60$ ft.
12. $b = 9\frac{1}{2}$ in., $h = 3\frac{7}{8}$ in.
13. $b = 3.6$ yd., $h = 1.2$ yd.
14. $b = 8\frac{1}{2}$ rd., $h = 5\frac{1}{4}$ rd.
15. $b = 6.75$ in., $h = 4.25$ in.

Area of a Triangle

THESE pictures show three different kinds of triangles. They also show that a triangle is **half of a parallelogram** having the same base and the same height as the triangle.



From the pictures you can easily see why the rule for finding the area of a triangle may be expressed either as

$$\text{Area} = \tfrac{1}{2} \times \text{base} \times \text{height},$$

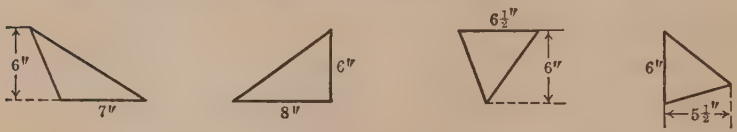
or as

$$A = \tfrac{1}{2}\, bh.$$

1. Find the area of each triangle formed by drawing either diagonal of a parallelogram with a base of 12 in. and a height of 6 in. Does it make any difference which diagonal you draw?

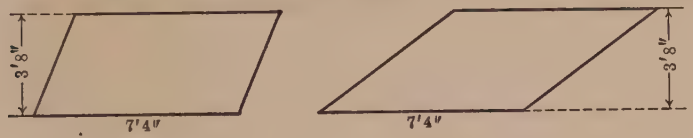
2. Draw triangles of these shapes, and in each case complete the parallelogram with the same base and height, as above.

3. Find the area of each of the four triangles shown below.

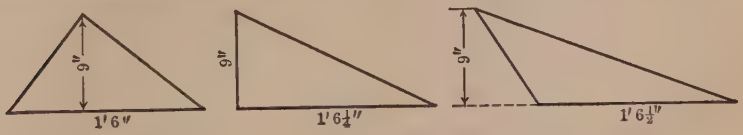


4. A school pennant in the form of a triangle has a base of 18 in. and a length (height) of 45 in. What fraction of a square yard is there in the pennant?

5. These two parallelograms are drawn to the same scale. Which, if either, has the larger area? Find the area of each.



6. These three triangles are all drawn to the same scale. Which has the largest area? Find the area of each one.



Find the areas of triangles with these bases and heights:

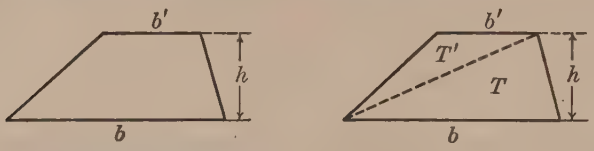
	Base (*b*)	Height (*h*)
7.	10 in.	$3\frac{1}{2}$ in.
8.	12 ft.	$4\frac{1}{4}$ ft.
9.	$5\frac{1}{2}$ ft.	$1\frac{1}{2}$ ft.
10.	$3\frac{1}{2}$ yd.	$2\frac{1}{4}$ yd.

	Base (*b*)	Height (*h*)
11.	$8\frac{1}{4}$ rd.	3 rd.
12.	$5\frac{3}{4}$ rd.	$2\frac{1}{2}$ rd.
13.	68 rd.	27 rd.
14.	$17\frac{1}{2}$ in.	$3\frac{1}{2}$ in.

15. What is the area of a triangle with a base of 3 in. and a height of 2 in.? a base of 6 in. and a height of 2 in.? a base of 3 in. and a height of 4 in.? a base of 6 in. and a height of 4 in.? a base of 9 in. and a height of 6 in.?

16. From Ex. 15, complete this statement: **Doubling either the base or the height of a triangle multiplies the area by ——; doubling both the base and the height multiplies the area by ——.**

HERE is a new figure which has not been given before in this book. It is called a **trapezoid.** As you can see, it is a four-sided figure in which **two opposite sides are parallel.**



As you can see from the second figure, the area is simply the sum of the areas of the triangles T and T'; that is,

$$\text{Area} = \tfrac{1}{2}\,bh + \tfrac{1}{2}\,b'h,$$

or

$$A = \tfrac{1}{2}\,h(b + b'),$$

which shows that the area A is the product of $\frac{1}{2}\,h$ and the sum of b and b'.

The example at the right shows how to find the area of a trapezoid in which the length of base b is 4 in., that of base b' is 2 in., and the height h is 3 in. The answer 9 means 9 sq. in.

$$A = \tfrac{1}{2}\,h(b + b')$$
$$= \tfrac{1}{2} \times 3 \times (4 + 2)$$
$$= \tfrac{1}{2} \times 3 \times 6 = 9$$

9 sq. in. *Ans.*

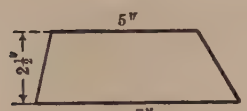
Find the areas of trapezoids which have these dimensions:

	b	b'	h
1.	3″	2″	1″
2.	$4\frac{1}{2}$″	$3\frac{1}{4}$″	2″
3.	5′	4′	$2\frac{1}{4}$′
4.	6″	$5\frac{1}{2}$″	4″

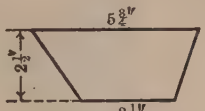
	b	b'	h
5.	$8\frac{1}{2}$′	6′	$3\frac{1}{2}$′
6.	10′	12′	$6\frac{1}{4}$′
7.	$7\frac{1}{2}$′	$5\frac{1}{2}$′	8′
8.	8′	10′	$6\frac{1}{2}$′

Find the area of each of the three trapezoids shown below:

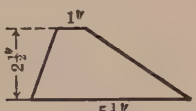
9.



10.



11.



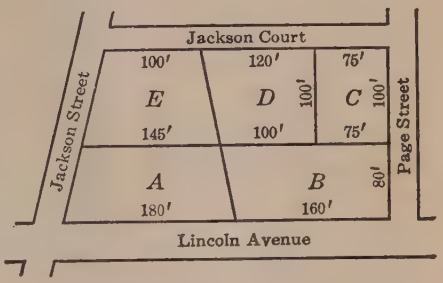
12. This map shows the size of the lots in a city block. How many kinds of geometric figures are represented in the picture?

13. Find the area of the rectangular lot *C*.

14. Find the area of lot *B*; of lot *D*.

15. What is the height of lot *E*? Find its area.

16. Find the area of lot *A*.



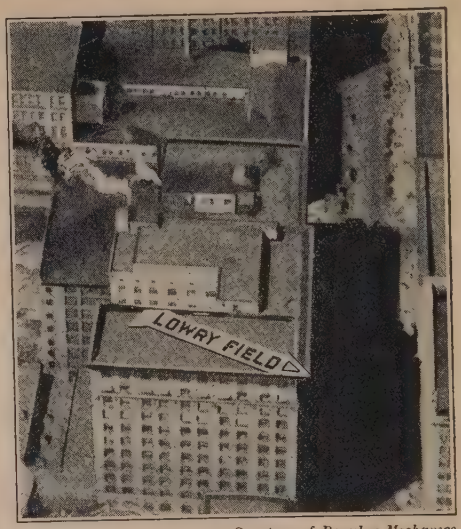
17. Using the formula for the area of a trapezoid, find the area of lot *C*, which may be regarded as a trapezoid in which the lower and upper bases are equal.

18. You may think of a triangle as a trapezoid in which the upper base is 0. Using the trapezoid formula, find the area of a triangle with a base of 4 in. and a height of 2 in.

19. The floor plan of a bay window is in the form of a trapezoid in which the bases are 10 ft. 6 in. and 6 ft. and the height is 4 ft. 4 in. How much additional floor space will there be in a room to which such a bay window is added?

20. Find the area of a trapezoid in which the bases are 12 ft. and 8 ft. and the height is 6 ft.; of one in which the bases are twice as long and the height is twice as great.

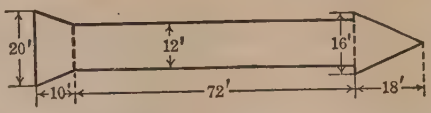
1. In order to direct aviators, many cities now put large signs on the roofs of tall buildings. Here is a picture of an airplane sign on the roof of a Denver building. The diagram below the picture shows the dimensions of the arrow. What is the total length of the arrow? What is its greatest width?



Courtesy of *Popular Mechanics*

2. How many square feet are there in the body of the arrow, which is a rectangle 72 ft. by 12 ft.?

3. The head of the arrow is a triangle with a base of 16 ft. What is its height? How many square feet are there in the head?



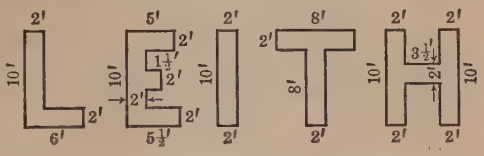
4. The tail of the arrow is a trapezoid. What is the length of each of its bases? What is its height? How many square feet are there in this part of the arrow?

5. Allowing 1 gal. to each 400 sq. ft., how many gallons of white paint, to the nearest $\frac{1}{4}$ gal., will it take to give the arrow 2 coats of paint?

6. The arrow can be seen from an airplane that is flying at a height of 0.9 mi. above the ground. From what height in feet can the arrow be seen?

7. Another airplane sign consists of an orange arrow painted on a black background that is 90 ft. long and 25 ft. wide. How many square yards does this sign cover?

8. This diagram shows the dimensions of the letters used in making an airplane sign. The letters are 3 ft. 6 in. apart. What is the length of the sign?



9. By drawing one short line, the letter L in the above diagram can be divided into two rectangles. What will their dimensions be? What is the total area of the letter L?

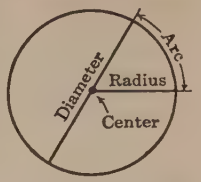
10. As in Ex. 9, find the area of each of the other four letters, and then find the total number of square feet to be covered in painting the sign.

11. On the roof of one of the buildings at an airport there is a letter N, with an arrow through it, to show aviators which direction is north. The N is 20 ft. high and 15 ft. wide, and is made of bars 3 ft. wide. Using the scale of 1 in. to 4 ft., make a scale drawing of the letter.

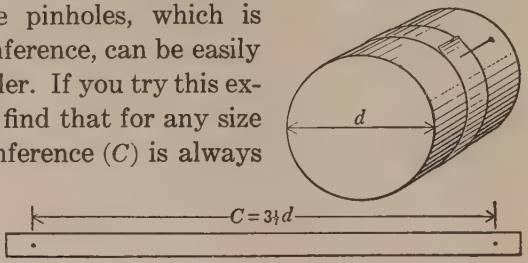
12. In the drawing made for Ex. 11, show how the letter can be divided into two rectangles and a parallelogram. Taking the base of the parallelogram as 17 ft. and its height as 3 ft., find the number of square feet that the letter covers.

13. Some planes have a "gliding ratio" of 12 to 1, which means that for every foot of height above the ground the plane can travel a horizontal distance of 12 ft. in gliding to earth without using its engine. If a plane has engine trouble while at a height of 3300 ft. over a city, how many miles, measured horizontally, can it travel before it reaches the ground?

THIS picture will help you to recall the special names that are used for different parts of a **circle**. The term **circumference**, as you also know, is used for the **length of the curve** which forms the circle; that is, it means the distance around the circle. It is easy to find the circumference of a circle if you know either the diameter or the radius.



Here is a picture showing a strip of paper pinned around a wooden cylinder. When the paper is unwrapped, the distance between the pinholes, which is equal to the circumference, can be easily measured with a ruler. If you try this experiment, you will find that for any size of circle the circumference (C) is always about $3\frac{1}{7}$ times the diameter (d) of the circle.



The rule for finding the circumference of a circle may therefore be expressed either as

$$\text{Circumference} = 3\tfrac{1}{7} \times \text{diameter},$$

or as the shorter and more convenient formula

$$C = 3\tfrac{1}{7}\, d.$$

This means, as shown at the right, that a circle with a diameter of 2.8 in. has a circumference of 8.8 in.

$$\begin{array}{r} 2.8 \leftarrow d \\ 3\frac{1}{7} \\ \hline 4 \\ 8\ 4 \\ \hline 8.8 \leftarrow C \end{array}$$

The diameter (d) of a circle is always twice the radius (r); that is, $d = 2\,r$. Since this is so, the formula for the circumference may also be expressed as

$$C = 6\tfrac{2}{7}\, r.$$

1. Kate's small brother Ted has a hoop that is $3\frac{1}{2}$ ft. in diameter. What is its circumference? How far will the hoop roll for each complete turn?

2. How many revolutions (turns) should Kate find that the hoop will make in rolling a distance of 110 yd.?

3. How far will a bicycle that has wheels 2 ft. 4 in. in diameter go for each revolution of the wheels? for each 5000 revolutions?

4. You will often see the formulas $C = 3\frac{1}{7}\,d$ and $C = 6\frac{2}{7}\,r$ given as $C = \pi d$ and $C = 2\,\pi r$, where the Greek letter π (pī) is used in place of $3\frac{1}{7}$. This value of π is sufficient for ordinary work, but for greater accuracy 3.1416 is sometimes used. Find, to the nearest 0.01 ft., the circumference of a circle with a radius of 15.68 ft., using first $3\frac{1}{7}$ and then 3.1416 for π.

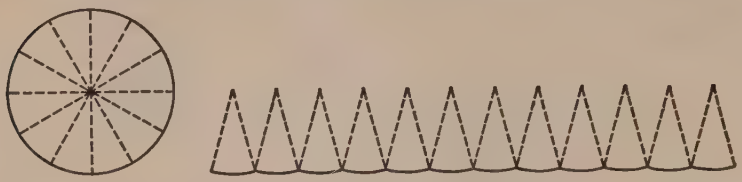
5. The formula $C = 3\frac{1}{7}\,d$ may be written as $\frac{22}{7}\,d = C$. Since C is $\frac{22}{7}$ times d, what fraction of C is d? Copy and complete: **A formula for the diameter of a circle is $d =$ ——.**

6. The class measured the equator on the globe in the schoolroom. They found it was 110 in. What was the diameter?

7. A group of boys measured the circumference of a circular water tank with a tape. They found it was 88 ft. around the tank. What was the diameter? What was the radius?

8. The outside diameter of a water pipe made of iron $\frac{1}{4}$ in. thick is 4 in. What is the inside circumference of the pipe?

THE picture below shows you how you can divide a circle into small figures that are nearly triangles. The **area of the circle** is evidently the sum of the areas of these figures.



The height of each figure is the radius, and the sum of their bases is the circumference. If the figures were exact triangles, you could find the area of each from the rule

$$\text{Area} = \tfrac{1}{2} \times \text{base} \times \text{height}.$$

For the area of the circle you could therefore write

$$\textbf{Area} = \tfrac{1}{2} \times \textbf{circumference} \times \textbf{radius},$$

or

$$A = \tfrac{1}{2} \times C \times r.$$

Later on, if you study geometry, you will find that this gives the true area of a circle.

Since $C = 6\frac{2}{7}\, r$,

then $A = \tfrac{1}{2} \times 6\frac{2}{7}\, r \times r$,

or $A = 3\frac{1}{7} \times r \times r$.

Just as 7×7, which is called **the square of 7**, may be written as 7^2 and read as "7-square," so $r \times r$ may be written as r^2 and read as "r-square" or as "**the square of the radius.**"

The formula for finding the area of a circle is therefore

$$A = 3\tfrac{1}{7}\, r^2.$$

1. This work shows how Kate used the formula on the opposite page in finding the area of a circle with a radius of 1.4 in. Check to see if her answer was right. Why did she give the area to the nearest 0.1 sq. in.?

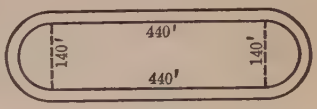
$$A = \frac{22}{\cancel{7}} \times \cancel{1.4} \times 1.4 = 6.16$$

0.2 — 1 — 6.2 sq. in. *Ans.*

2. The circular face of a schoolroom clock is 14 in. in diameter. How many square inches are there in the face?

3. You will often see the formula $A = 3\frac{1}{7}\, r^2$ given as $A = \pi r^2$, where π, as on page 441, stands for $3\frac{1}{7}$ or 3.1416. Using each value of π, find the area of a circle with a radius of 6.3 in.

4. This diagram shows a race track with semicircular ends. What part of a mile is it around the inside edge of the track?



5. In Ex. 4, find the area of the space inclosed by the track.

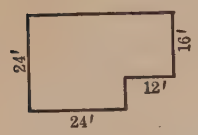
6. If you double the radius of a circle, by what does this multiply the circumference? the area?

Find the numbers that belong in the blank spaces:

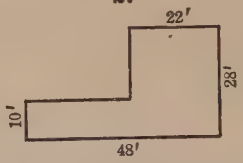
	Diameter (d)	Radius (r)	Circumference (C)	Area (A)
7.	$10\frac{1}{2}$ ft.	----------	----------	----------
8.	4.2 in.	----------	----------	----------
9.	----------	$3\frac{1}{2}$ in.	----------	----------
10.	----------	----------	4.4 yd.	----------
11.	----------	4.2 in.	----------	----------
12.	----------	----------	26.4 ft.	----------

The three diagrams below show the dimensions of cellars. Find the number of square feet of floor space in each one:

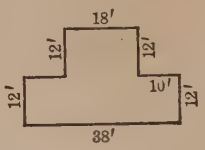
1.



2.



3.



4. In Exs. 1 to 3, which cellar has the largest area? the smallest area? What is the difference between them?

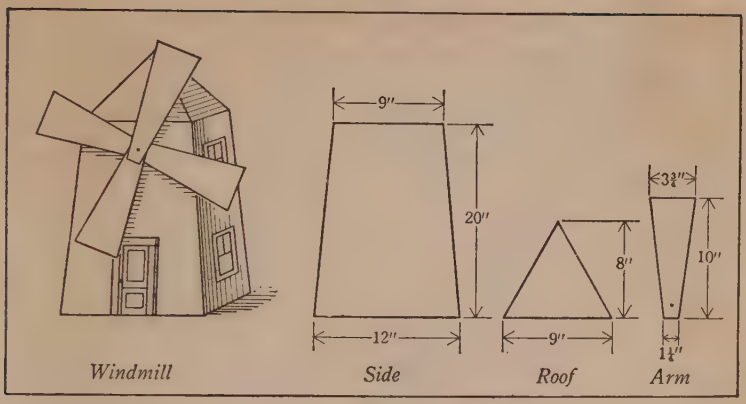
5. How many acres (160 sq. rd.) are there in a field that is a parallelogram with a base of 80 rd. and a height of 16 rd.?

6. Mr. Gray has 220 ft. of wire netting. If he should make a rectangular yard for his chickens, making one dimension 50 ft., what would be the area of the yard?

7. In Ex. 6, if Mr. Gray should make a circular yard, what would be the diameter? What would be the area?

For each figure find what is specified in the third column:

	FIGURE	DIMENSIONS	FIND
8.	Triangle	$b = 1'\ 6''$, $h = 10''$	Area
9.	Parallelogram	$b = 32''$, $h = 18''$	Area
10.	Trapezoid	$b = 6'$, $b' = 4'$, $h = 2'$	Area
11.	Rectangle	$b = 4\frac{1}{2}''$, $h = 3''$	Perimeter Area
12.	Square	Side $= 2'\ 6''$	Perimeter Area
13.	Circle	$r = 17\frac{1}{2}''$	Circumference Area



1. Jim found this picture in a book describing things that boys and girls can make. The diagrams at the right show the dimensions for the various parts. What is the area in square inches of each side of the windmill?

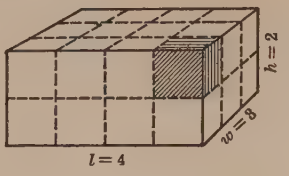
2. What is the total number of square inches in the roof, which is made up of four triangles?

3. Find the area of a trapezoid which has the dimensions shown for each arm of the sails.

4. Jim's aunt has a summer gift shop. She thought it would be a good idea to build a new shop in the shape of this windmill. She had the carpenter make each side 15 ft. wide at the bottom, 12 ft. wide at the top, and 20 ft. high. She and Jim painted the sides white. Not allowing for doors and windows, find how many square feet they painted white.

5. In Ex. 4, each triangle that made the roof had a height of 10 ft. and a base of 12 ft. They painted the roof green. How many square feet did the green paint have to cover?

THIS picture of a rectangular solid 4 in. long, 3 in. wide, and 2 in. high will help you to recall the method of finding the volume. By counting the 1-inch cubes into which the figure can be divided, as shown by the dotted lines, you can see that the number of cubic inches in the volume is



$$4 \times 3 \times 2, \text{ or } 24.$$

The rule for the volume of a rectangular solid, which is

Volume = length × width × height,

can be more easily remembered by means of the formula

$$V = lwh.$$

---

1. This work shows how Jim found the volume of a rectangular solid that was 6 in. long, $3\frac{1}{2}$ in. wide, and $2\frac{1}{2}$ in. high. He gave the answer as $52\frac{1}{2}$ cu. in. Check the work to see if Jim's answer was right.

$$V = \overset{3}{\cancel{6}} \times \frac{7}{\cancel{2}} \times \frac{5}{2} = \frac{105}{2} = 52\tfrac{1}{2}$$

$52\frac{1}{2}$ cu. in. *Ans.*

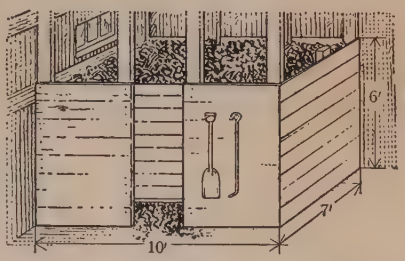
2. Find the volume of a cube that is $3\frac{1}{2}$ in. on an edge.

3. How many cubic feet of storage space are there in a storeroom that is 50 ft. long, 40 ft. wide, and 10 ft. high?

4. A bar 6 ft. long and 3 in. square is made of steel that weighs 490 lb. to the cubic foot. What is its weight?

5. There are 231 cu. in. in a gallon. How many gallons of maple sap will it take to fill a rectangular pan 44 in. long and 28 in. wide to a depth of 3 in.?

6. Here is a picture of the coal bin in Mr. Fiske's cellar. A ton of hard coal occupies 35 cu. ft. of space. How many tons will it take to fill the bin level full?



7. Soft coal occupies about 42 cu. ft. of space per ton. How many tons of soft coal would it take in Ex. 6?

8. The ventilator opening in a schoolroom is a rectangle 24 in. wide and 20 in. high. When fresh air is being forced through it at the rate of 25 ft. per minute, how many cubic feet of fresh air are forced into the room in 10 min.?

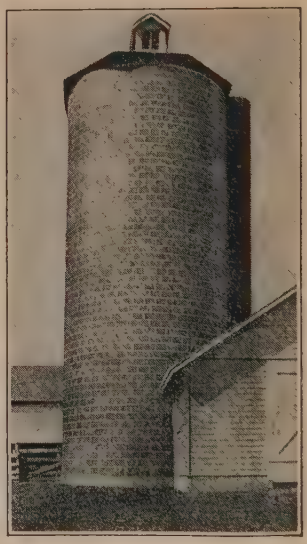
9. Find the volume of a rectangular solid 5 ft. by 4 ft. by 3 ft.; of one 10 ft. by 4 ft. by 3 ft.; of one 10 ft. by 8 ft. by 3 ft.; of one 10 ft. by 8 ft. by 6 ft.

10. From Ex. 9, complete these statements: **Doubling one dimension of a rectangular solid multiplies the volume by ——; doubling two dimensions multiplies the volume by ——; doubling all three dimensions multiplies the volume by ——.**

Find the numbers that belong in the blank spaces:

	Length (l)	Width (w)	Height (h)	Volume (V)
11.	7 ft.	6 ft.	$3\frac{1}{2}$ ft.	----------
12.	$4\frac{1}{2}$ in.	$3\frac{3}{4}$ in.	$2\frac{1}{4}$ in.	----------
13.	4 ft.	----------	2 ft.	24 cu. ft.
14.	----------	5 in.	5 in.	125 cu. in.
15.	2.5 ft.	1.4 ft.	----------	2.8 cu. ft.

HERE is a picture of a **cylindric silo** such as is used on farms for storing feed for the cattle. If you think of a large piece of canvas as fitted round this silo and then unrolled, you will see why the curve surface may be regarded as a rectangle in which one dimension is the circumference and the other is the height of the cylinder. For this surface,



Area = circumference × height,

or, using S to represent "area of curve surface,"

$$S = Ch.$$

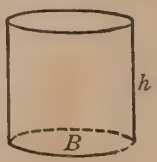
Common cylinders have a circular base, and so $C = 3\frac{1}{7}\,d$. You will often find it more convenient to use

$$S = 3\tfrac{1}{7}\,dh.$$

In the rule "Volume = length × width × height" for the volume of a rectangular solid, "length × width" gives the area of the base. This rule could therefore have been written as

Volume = area of base × height.

You can use this rule for finding the **volume of a cylinder**, or, letting B represent "area of base," you can use the formula



$$V = Bh.$$

In a cylinder with a circular base, $B = 3\frac{1}{7}\,r^2$. It is often more convenient to find the volume from the formula

$$V = 3\tfrac{1}{7}\,r^2h.$$

1. Suppose that in the silo shown on the opposite page the outside diameter is 14 ft., and the height to the roof is 32 ft. What is the area in square feet of the curve surface?

2. Mr. Brown's silo has a diameter of 12 ft. and a height of 28 ft., inside measurements. What is the radius? What is the capacity of the silo in cubic feet?

3. The inside diameter of a circular water tank is $10\frac{1}{2}$ ft. How many cubic feet of water are there in the tank when it is filled to a depth of 15 ft.? At $7\frac{1}{2}$ gal. to the cubic foot, what is the number of gallons?

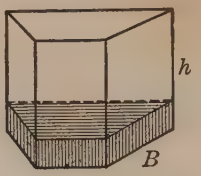
4. A cylindric hot-water tank that is 14 in. in diameter and 5 ft. high, inside measurements, is advertised as a 40-gallon tank. Taking 231 cu. in. to the gallon, find whether or not this is the correct capacity.

5. The cylinder of Mrs. Fry's ice-cream freezer is $5\frac{1}{4}$ in. in diameter and 8 in. high, inside measurements. In order to allow for expansion in freezing, she fills it only $\frac{2}{3}$ full of the ice-cream mixture at the start. How many quarts (see Ex. 4) of the mixture does she put in?

Find the numbers that belong in the blank spaces:

	Radius of Cylinder	Height of Cylinder	Circumference of Cylinder	Area of Curve Surface	Volume of Cylinder
6.	$3\frac{1}{2}$ in.	10 in.	-------	-------	-------
7.	4 ft.	14 ft.	-------	-------	-------
8.	-------	12 in.	22 in.	-------	-------
9.	-------	8 in.	-------	352 sq. in.	-------
10.	15.4 ft.	45 ft.	-------	-------	-------

HERE is a picture of a **prism** which has trapezoids for its bases. The **volume of any prism,** regardless of the shape of its bases, can be found by the same rule as was given for the volume of a cylinder on page 448; namely,



Volume = area of base × height,

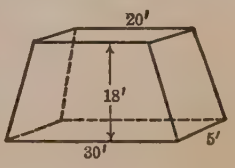
or $V = Bh$.

You can see the reason for this by thinking of a hollow prism with a height of 5 in. and a base containing 20 sq. in. If you pour in water to a depth of 1 in., as shown by the shaded portion, it will take 20 cu. in. of water. It will therefore take 5 times this amount to fill the prism, and so the number of cubic inches in the volume of the prism is 20 × 5, or 100.

1. This picture shows the shape and dimensions of a railroad cut which runs at approximately the same depth (9 ft.) for a distance of 480 ft. About how many cubic yards of earth and rock were removed in making the cut?

2. An irrigation ditch, shaped like the railroad cut in Ex. 1, is 2 ft. wide at the bottom and 3 ft. wide at the surface of the water, which is $1\frac{1}{2}$ ft. deep. How many cubic feet of water will such a ditch hold per mile?

3. In carrying its tracks over a highway, a railroad built a vertical concrete wall of the shape and dimensions here shown. What is the area of the trapezoid forming the front face? What is the thickness of the wall? How many cubic yards of concrete were used?



THIS picture shows an interesting experiment that you may like to try. Make a paper **cone of the same size of base and the same height as a hollow cylinder** such as a tomato can. Fill the cone with water or sand and pour it into the can. You can do this exactly 3 times before the can is full. This shows that for the **volume of a cone** you can write

$$\text{Volume} = \tfrac{1}{3} \times \text{area of base} \times \text{height}.$$

The same is also true for any pyramid, and so the formula for the volume of each of these two solids is

$$V = \tfrac{1}{3} Bh.$$

1. A cylindric can $3\frac{1}{2}$ in. in diameter and 6 in. high will hold how many times as much as a hollow cone with the same height and a base of the same size? What is the volume of each?

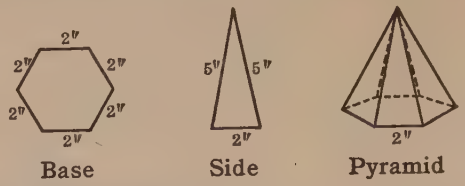
2. A stone monument is capped by a pyramid having a base that is 24 in. square and a height of 18 in. How many cubic inches of stone are there in the pyramid?

Find the volumes of pyramids and cones with these dimensions:

	Area of Base	Height of Pyramid
3.	12 sq. in.	4 in.
4.	25 sq. ft.	$4\frac{1}{2}$ ft.
5.	1600 sq. ft.	36 ft.

	Area of Base	Height of Cone
6.	36 sq. in.	9 in.
7.	$68\frac{1}{2}$ sq. ft.	$7\frac{1}{2}$ ft.
8.	825 sq. ft.	$10\frac{1}{2}$ ft.

ONE day the class made cardboard models of some of the geometric solids that they had been studying. This diagram shows the dimensions used in making the model of a hexagonal pyramid. The faces were fastened together with strips of adhesive tape.



Base Side Pyramid

Starting with a circle having a radius of 2 in., how would you draw inside it a regular hexagon 2 in. on a side? How would you draw an isosceles triangle with a base of 2 in. and equal sides of 5 in.? How many of these triangles would you need? Not allowing for overlapping at the corners, how much tape would you need to fasten the faces together?

Describe briefly how you would make models of each of the following solids, and in each case find the number of inches of tape (not allowing for overlapping) needed to hold the faces together:

1. A cube 3 in. on each edge.

2. A rectangular solid 6 in. by 4 in. by $3\frac{1}{2}$ in.

3. A hexagonal prism with a base 3 in. on each side and a height of 6 in.

4. A triangular prism with a base $3\frac{1}{2}$ in. on each side and a height of 4 in.

5. A triangular pyramid with a base 4 in. on each side, the other faces being isosceles triangles with equal sides of 6 in.

6. A cylinder with a diameter of $3\frac{1}{2}$ in. and a height of 5 in. (Remember that it will take one strip to fasten together the edges of the piece forming the curve surface.)

1. Allowing $1\frac{1}{4}$ cu. ft. to the bushel, find the number of bushels of grain in a rectangular bin which is 10 ft. by 6 ft. and is filled to a depth of 4 ft.

2. The tin cans used for vegetables are numbered according to their size. A No. 1 can has a height of $4\frac{1}{2}$ in. and a diameter of 3 in., a No. 2 can is $4\frac{1}{2}$ in. high with a diameter of $3\frac{3}{8}$ in., and a No. 3 can is $4\frac{3}{4}$ in. high with a diameter of $4\frac{1}{4}$ in. Find, to the nearest 0.1 cu. in., the capacity of each size of can.

3. In Ex. 2, the capacity of a No. 2 can is what per cent larger than that of a No. 1 can? It is what per cent smaller than that of a No. 3 can?

4. Measure the circumference of a baseball as accurately as you can, and then find the diameter, the radius, and the area of the circle that would be formed by cutting the ball in half.

5. Mary is making some gilt cones to hold candy to put on her Christmas tree. The cones are 6 in. long and $3\frac{1}{2}$ in. across the top. How many cubic inches will each one hold?

6. In Ex. 5, if the candy comes in a box 6 in. by $3\frac{1}{2}$ in. by $2\frac{3}{4}$ in., how many cones will the candy fill?

7. At the gas works, one of the storage tanks is 84 ft. in diameter and 50 ft. high. How many cubic feet of gas will it hold? At \$1.20 per 1000 cu. ft., how much is this gas worth?

8. Farmers often estimate the number of tons of hay in a rectangular mow by dividing the product of the three dimensions in yards by 18. How many tons would this give for a mow that is 30 ft. by 18 ft. by 12 ft.?

9. In Ex. 8, find the number of tons by taking 500 cu. ft. as the space occupied by 1 T. of hay. Is this more or less than the estimated amount in Ex. 8? How much more or less?

1. Good roads are of great importance to every community. In one county where the average value of the land was \$80 per acre, the building of good roads increased this average to \$86. What was the per cent of increase?

2. A farmer who lived at some distance from the railroad used to be able to haul only 80 bu. of wheat per day to the station. Over improved roads he now hauls 200 bu. per day. In hauling 8000 bu., how many days do the good roads save?

3. The average cost of hauling by motor truck in this country is 23¢ per ton per mile. At this price, how much would it cost to haul 25 T. of hay 8 mi. to market?

4. Over concrete roads the cost of hauling is estimated at 10¢ per ton per mile. How much could be saved in Ex. 3 if the roads were all concrete? To how much does this saving amount in a month in which 6200 T. are hauled?

5. Mr. Kent used to haul 4 bales of cotton to a load and made only 1 trip per day to the railroad. Over an improved road, he now hauls 6 bales to the load and makes 2 trips a day. He now hauls how many times as many bales per day? What per cent more work does he now do per day?

6. Mr. Brown raises about 18 T. of farm produce per year. He has to haul it $5\frac{1}{2}$ mi. to market, which costs him 28¢ per ton per mile. If an improved road would reduce this cost to 16¢ per ton per mile, how much per year would the good road be worth to Mr. Brown?

7. At $2.50 per square yard, how much will it cost per mile to build a road 30 ft. wide?

8. The national government, under certain conditions, pays part of the cost of building new roads. In one state the national government has paid a total of about $11,200,000 in building 540 mi. of roads. To the nearest $1, to how much did this amount per mile?

9. A new highway 5.4 mi. long and 40 ft. wide was built between two cities at a cost of $2.40 per square yard. If 20% of the total cost was paid by the national government, 30% by the state government, and the rest was divided equally between the two cities, how much was the share of each?

10. A contract for building 5194 ft. of state highway with a macadam surface was let for $37,313.50. To the nearest cent, what was the cost per foot of this construction?

11. In the same year as in Ex. 10, a contract for building 13,089 ft. of state highway with a concrete surface was let for $156,992.50. To the nearest cent, what was the cost per foot for this type of road? This was how much more or less than the cost for the macadam road in Ex. 10?

See how quickly you can do these additions:

1.	2.	3.	4.	5.
987	$35.01	485.1	$35\frac{1}{2}$	6 ft. 9 in.
305	6.95	70.8	$7\frac{3}{4}$	3 ft. 4 in.
862	87.39	6.3	$8\frac{1}{8}$	1 ft. 8 in.
79	77.56	125.0	$10\frac{1}{2}$	2 ft. 6 in.
285	21.07	645.7	$6\frac{5}{8}$	5 ft. 0 in.
160	9.50	29.8	$12\frac{3}{8}$	9 in.

See how quickly you can do these subtractions:

6.	7.	8.	9.	10.
572	$49.75	6.072	$28\frac{3}{8}$	358 ft.
398	28.98	4.985	$19\frac{3}{4}$	295 ft.

See how quickly you can do these multiplications:

11. 275×306
12. 550×982
13. $0.087 \times \$598$
14. 3.14×28 ft.
15. $3\frac{1}{7} \times 42$ in.
16. 5.25×24 ft.

See how quickly you can do these divisions:

17. $9499 \div 29\frac{1}{2}$
18. $67.64 \div 8.9$
19. $\$41.36 \div 0.055$
20. 5280 ft. $\div 16\frac{1}{2}$
21. 121 in. $\div 3\frac{1}{7}$
22. 132 yd. $\div 5\frac{1}{2}$

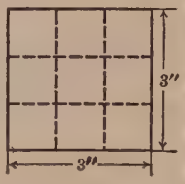
Find the missing numbers:

23. 42×18 ft. $=$ —— ft.
24. $\$28 \div 0.07 = \$$——
25. —— ft. $\div 3\frac{1}{7} = 7$ ft.
26. $8 \times$ —— in. $= 56$ in.
27. ——% of \$10 is \$2.50
28. $\frac{1}{3} \times 12 \times 6 =$ ——
29. $\frac{1}{2} \times$ —— $\times 8 = 40$
30. $\frac{1}{2} \times 4 \times$ —— $= 16$
31. $3\frac{1}{7} \times 7 \times$ —— $= 154$
32. $16 \times$ —— $\times 4\frac{1}{2} = 720$

Squares and Square Roots

AS YOU have already learned, 3×3 may be written as 3^2, which is read either as "the square of 3" or as "3-square." Thus, in finding the area of a square that is 3 in. on a side, as in this figure, you can write

$$3 \times 3 = 3^2 = 9.$$



The 3 is called the **square root** of 9. A square root is indicated by the sign $\sqrt{\ }$, called the **radical sign**; that is, in this case,

$$\sqrt{9} = 3.$$

You can tell the squares and square roots of some of the smaller whole numbers and of certain simple fractions and decimals at a glance. Study the three examples given below:

(1) $7 \times 7 = 49$	(2) $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$	(3) $0.5 \times 0.5 = 0.25$
$7^2 = 49$	$\left(\frac{1}{2}\right)^2 = \frac{1}{4}$	$0.5^2 = 0.25$
$\sqrt{49} = 7$	$\sqrt{\frac{1}{4}} = \frac{1}{2}$	$\sqrt{0.25} = 0.5$

Tell the squares of each of these numbers:

1. 4	3. 8	5. 10	7. $\frac{1}{3}$	9. $\frac{2}{3}$	11. 0.2
2. 5	4. 9	6. 12	8. $\frac{1}{4}$	10. $\frac{7}{8}$	12. 0.06

Tell the square roots of each of these numbers:

13. 4	16. 36	19. 100	22. $\frac{1}{9}$	25. $\frac{4}{9}$	28. 0.36
14. 16	17. 81	20. 144	23. $\frac{1}{16}$	26. $\frac{9}{25}$	29. 1.44
15. 25	18. 64	21. 121	24. $\frac{1}{49}$	27. $\frac{16}{81}$	30. 0.0025

YOU probably cannot tell at a glance that $1225 = 35 \times 35$, but you can see that 1225 is divisible by 5 because it ends in 5. Dividing as shown at the right, you can then see that 245 is divisible by 5, and that the quotient 49 is the square of 7. In this way you can find that

$$1225 = (5 \times 7) \times (5 \times 7),$$

and so $\sqrt{1225} = 5 \times 7$, or 35;

that is, the square root of 1225 is 35.

$$\begin{array}{r} 5\overline{)1225} \\ 5\overline{)245} \\ 7\overline{)49} \\ 7 \end{array}$$

$$\sqrt{1225} = 5 \times 7 = 35$$

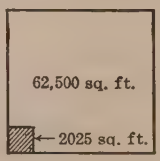
This method will not work with a number like 745, **which does not have an exact square root.** By methods that you will learn later, you can find that $\sqrt{745} = 27.3$ to the nearest 0.1, or 27.29 to the nearest 0.01. These roots **are only approximate,** because $27.3^2 = 745.29$ and $27.29^2 = 744.7441$, but they are sufficiently accurate for most practical purposes.

By trying different divisors, find the square root of

1. 225	3. 441	5. 576	7. 625	9. 20.25
2. 400	4. 324	6. 1296	8. 900	10. 10.89

11. This diagram shows a square building lot which contains 62,500 sq. ft. What is the length of each side?

12. The shaded portion in the lower left corner shows the space occupied by a square store building. What is the length of each side of this building?



13. Find the perimeter of a square building lot which contains 25,600 sq. ft.

YOU can easily show that $35 \times 35 = 1225$. As shown below, you can also find the square of 35 by considering 35 as the sum of 3 tens and 5 ones; that is, as $30 + 5$.

$$
\begin{array}{rll}
 & 30+5 & \\
 & 30+5 & \\
\hline
 & (30\times 5)+5^2 & \leftarrow 5\times(30+5) \\
30^2+ & (30\times 5) & \leftarrow 30\times(30+5) \\
\hline
 & 30^2+2\times(30\times 5)+5^2 & \leftarrow (30+5)^2 \\
\multicolumn{3}{l}{=30^2+5\times(2\times 30+5)} \\
\multicolumn{3}{l}{=900+5\times 65=900+325=1225}
\end{array}
$$

Now suppose that you have the number 1225 and wish to find its square root. To do so, you can simply reverse the steps taken in the above multiplication and proceed as shown below:

Given number →	1225	$30+5$	← Square root
	900	← 30^2	
2×30 →	60	325	
$2\times 30+5$ →	65	325	← $5\times(2\times 30+5)$

Since $30^2 = 900$ and $40^2 = 1600$, the largest square in 1225 is 30^2, and so **the first part of the square root is 30.**

As shown in the multiplication above, the remainder 325 left after subtracting 900 from 1225 is equal to $5 \times (2 \times 30 + 5)$. Now **$2 \times 30$ is twice the part of the root already found,** and so you can **use 60 as a trial divisor.** Since $325 \div 60 = 5 +$, add 5 to the 60 and **take 65 as the complete divisor.**

Then $5 \times 65 = 325$ and $325 - 325 = 0$. The **second part of the square root is therefore 5,** and so $\sqrt{1225} = 30 + 5$, or 35.

THIS example shows how to find the square root of 655.36 by the method on page 459. Study it carefully and compare the work step by step with the summary given below:

		2	5 . 6	← Square root
		6	55 . 36	← Given number
Largest square →		4		← 2^2
1st trial divisor →	40	2	55	← 1st remainder
1st complete divisor →	45	2	25	← 5×45
2d trial divisor →	500		30 36	← 2d remainder
2d complete divisor →	506		30 36	← 6×506

Check. $25.6^2 = 25.6 \times 25.6 = 655.36$

1. Separate the given number into **groups of two figures each**, beginning at the decimal point. There will be **one figure of the root for each group.** The left-hand group may have either one or two figures, as in 6 55 . 36 and 22 06 . 45 27.

2. Find the **largest square in the left-hand group** and write its square root as **the first figure** of the required root.

3. **Subtract** the square and **bring down the next group.**

4. Take **twice the part of the root already found, regarded as tens,** as the trial divisor and **divide to find the second figure** of the root. In the above case $2 \times 2 = 4$, and so the first trial divisor is 40.

5. **Add** the result in step 4 to the trial divisor to make the complete divisor, **multiply,** and **subtract** as in long division.

6. **Bring down the next group** and proceed as before until **all the groups are used** or the **desired number of decimal places is reached.** Annex zeros at the right of the number if necessary.

Find the square root of each of these numbers:

1. 1600	3. 961	5. 27.04	7. 556.96	9. $\frac{529}{625}$
2. 2500	4. 2025	6. 42.25	8. 158.76	10. $\frac{1156}{1225}$

11. Since $2^2 = 4$ and $3^2 = 9$, you can see that 7 cannot have an exact square root. First writing 7 as 7 . 00 00, find the square root of 7 to the nearest 0.1.

Find the square root in each case to the nearest 0.1:

12. 18 13. 35 14. 46 15. 143 16. 567 17. 881

18. The work at the right shows how to find the square root of 11,728.89. Compare it step by step with the summary on page 460. Why is the first trial divisor 200? Why is the second figure of the root 0? After bringing down the 28, how do you find the 8 in the root? Check the square root by multiplication.

	1	0	8 . 3
	1	17	28 . 89
	1		
200		17	28
208		16	64
2160		64	89
2163		64	89

19. As in Ex. 18, find the square root of 11,342.25; of 90,420.49.

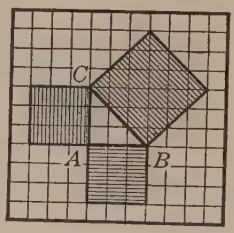
Find the square root in each case to the nearest 0.01:

20. 65	22. 41	24. 734	26. 1244	28. 2680
21. 72	23. 123	25. 976	27. 1356	29. 3775

30. Find, to the nearest 0.1 rd., the length of each side of a square field that contains 1 A. (1 A. = 160 sq. rd.).

31. In making a yard for his turkeys, Mr. Rogers allows $2\frac{1}{2}$ sq. yd. for each bird. If he has 200 turkeys and makes the yard in the form of a square, what length, to the nearest 0.1 ft., should he use for each side?

THE discovery of a very interesting and important fact about right triangles is credited to a Greek teacher named **Pythagoras**, who lived about 2500 yr. ago. You can discover this fact for yourself by studying the accompanying figure.



By counting, you will find that in each of the shaded squares on the sides AB and AC of the right triangle ABC there are 9 small squares, and in the square on the side BC there are 18 small squares.

The side opposite the right angle of a right triangle is called the **hypotenuse**, and so this fact is usually stated as follows:

The square on the hypotenuse of a right triangle is equal to the sum of the squares on the other two sides.

For example, suppose that you have a right triangle ABC in which A is the right angle, the side AB is 3 in. long, and the side AC is 4 in. long. As shown in the work below, you can find that the square on the hypotenuse BC would contain 25 sq. in., and so the length of the hypotenuse BC is 5 in.

$$(BC)^2 = (AB)^2 + (AC)^2 = 3^2 + 4^2 = 9 + 16 = 25$$
$$BC = \sqrt{25} = 5$$ 5 in. *Ans.*

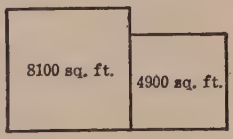
Find, to the nearest 0.1, the hypotenuse of a right triangle in which the lengths of the other two sides are as follows:

1. 15 in., 20 in.
2. 21 in., 28 in.
3. 24 in., 32 in.
4. 42 ft., 64 ft.
5. 51 ft., 68 ft.
6. 63 rd., 84 rd.
7. 9.0″, 8.7″
8. 98.1′, 130.8′
9. 156.3′, 208.4′

10. In a rectangular room 24 ft. long and 18 ft. wide, what is the length of a line drawn diagonally across the floor between two opposite corners?

11. Find, to the nearest 0.1 in., the length of the diagonal of a rectangle that is 5.2 in. long and 4.4 in. wide.

12. This diagram shows two adjoining lots which front on the same street. Taking the areas as shown in the diagram, find the combined frontage of the lots.



13. In Ex. 12, what is the distance, to the nearest 0.1 ft., from the upper left corner of the larger lot to the lower right corner of the smaller lot?

14. The dining room in Ted's home is 16 ft. long, 12 ft. wide, and 9 ft. high. What is the length of a diagonal of the floor? What is the distance, to the nearest 0.1 ft., from an upper corner of the room to the opposite lower corner?

15. From the formula $A = 3\frac{1}{7}r^2$, which gives the area of a circle in terms of the radius r, you can see that $r^2 = A \div 3\frac{1}{7}$, or $r^2 = \frac{7}{22}A$, from which $r = \sqrt{\frac{7}{22}A}$. When $A = 154$, what is the value of r^2? of r? What is the radius of a circle which has an area of 154 sq. in.? of 154 sq. ft.?

16. Find the radius of a circle with an area of 616 sq. in.

17. Find, to the nearest 0.1 in., the radius of a circle which has an area of 22 sq. in.; of 98.56 sq. ft.

Find, to the nearest 0.1, the radius of a circle in which the area in each case is as follows:

18. 44 sq. in.

19. 11 sq. in.

20. 121 sq. ft.

21. 9.24 sq. in.

22. 27.06 sq. ft.

23. 18.48 sq. yd.

1. What is the length of each side of a square field that contains 15,255 sq. rd.? What is the perimeter?

2. Find the perimeter of a square field with an area 4 times as large as that of the field in Ex. 1.

3. Find the hypotenuse of a right triangle in which the lengths of the other two sides are 4.2 in. and 5.6 in.

4. A park is 425 ft. long and 238 ft. wide. What distance, to the nearest foot, can be saved by walking diagonally across the park instead of walking around two of its sides?

5. By first finding the diagonal of one face, find, to the nearest 0.1 in., the diagonal of a cube 6 in. on an edge.

Tell at sight the square of each of these numbers:

6. 8 7. 1.1 8. 0.9 9. $\frac{1}{4}$ 10. $\frac{2}{3}$ 11. $\frac{3}{4}$

Tell at sight the square root of each of these numbers:

12. 16 14. 1.21 16. 3600 18. $\frac{1}{16}$ 20. $\frac{16}{25}$

13. 25 15. 0.49 17. 8100 19. $\frac{9}{16}$ 21. $\frac{49}{81}$

In each case find the square root to the nearest 0.1:

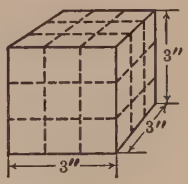
22. 38 23. 75 24. 140 25. 1650 26. 8276

Find, to the nearest 0.1, the hypotenuse of a right triangle in which the other two sides are as follows:

27. 3.6 in., 4.8 in.
28. 50 ft., 30 ft.
29. 8.1 in., 10.8 in.
30. 12.2 ft., 18.5 ft.
31. 54.2 ft., 68.4 ft.
32. 1250 ft., 1860 ft.

JUST as 3×3 may be written as 3^2, so $3 \times 3 \times 3$ may be written as 3^3, which is read either as "**the cube of 3**" or as "**3-cube.**" In finding the volume of a cube that is 3 in. on an edge, as in the accompanying figure, you can therefore write

$$3 \times 3 \times 3 = 3^3 = 27$$



The cube of 3 is 27, and so 3 is called the **cube root** of 27. A cube root is indicated by the sign $\sqrt[3]{\ }$; that is, in this case,

$$\sqrt[3]{27} = 3$$

Study these examples which show how you can find the cube roots of certain small whole numbers, decimals, and fractions:

(1) $5\overline{)125}$
$5\overline{)25}$
5

$125 = 5^3$

$\sqrt[3]{125} = 5$

(2) $0.6\overline{)0.216}$
$0.6\overline{)0.36}$
0.6

$0.216 = 0.6^3$

$\sqrt[3]{0.216} = 0.6$

(3) $\sqrt[3]{\frac{8}{27}} = \sqrt[3]{\frac{2 \times 2 \times 2}{3 \times 3 \times 3}}$

$\frac{8}{27} = \left(\frac{2}{3}\right)^3$

$\sqrt[3]{\frac{8}{27}} = \frac{2}{3}$

Find the cube root of each of these numbers:

1. 64	3. 512	5. 0.125	7. 3.375	9. $\frac{1}{64}$
2. 216	4. 729	6. 1728	8. 64,000	10. $\frac{27}{125}$

Find the edge of a cube which has a volume of

11. 343 cu. in.	14. 2.744 cu. ft.	17. $\frac{1}{27}$ cu. yd.
12. 1000 cu. in.	15. 1.728 cu. in.	18. $\frac{27}{64}$ cu. in.
13. 3375 cu. ft.	16. 27,000 cu. ft.	19. $\frac{64}{125}$ cu. ft.

Using a Table of Roots

MOST people today **find squares, cubes, square roots, and cube roots from a table** instead of computing them by long methods. On the opposite page is given a small table which will show you how larger tables are used.

The squares and cubes of all numbers from 1 to 100 can be read directly from the table.

For example, from the columns headed "Squares" and "Cubes," you can find that $44^2 = 1936$ and $62^3 = 238{,}328$.

The square roots and cube roots of all numbers from 1 to 100 can be read directly from the table.

For example, by looking in the columns headed "Square Roots" and "Cube Roots," you can find that $\sqrt{65} = 8.062$ and $\sqrt[3]{35} = 3.271$, each to the nearest 0.001.

The square roots of certain numbers from 101 to 10,000 and the cube roots of certain numbers from 101 to 1,000,000 can also be found from the table.

From the column headed "Squares," you can see that 2209 is given as the square of 47; that is, $2209 = 47^2$. You can thus find that $\sqrt{2209} = 47$.

Similarly, from the column headed "Cubes," you can find that $421{,}875 = 75^3$, and so $\sqrt[3]{421{,}875} = 75$.

By moving decimal points, the table can be still further extended in finding roots.

For example, you know that $100 = 10 \times 10$, and so in finding $\sqrt{3000}$, you should first notice that $3000 = 100 \times 30$. You can then find from the table that $\sqrt{30} = 5.477$, and so in finding $\sqrt{3000}$ you have $\sqrt{3000} = \sqrt{100 \times 30} = 10 \times 5.477 = 54.77$.

Similarly, since $0.01 = 0.1 \times 0.1$, in finding $\sqrt{0.61}$, you have $\sqrt{0.61} = \sqrt{0.01 \times 61} = 0.1 \times 7.810 = 0.7810$.

No.	Squares	Cubes	Square Roots	Cube Roots	No.	Squares	Cubes	Square Roots	Cube Roots
1	1	1	1.000	1.000	51	2 601	132 651	7.141	3.708
2	4	8	1.414	1.260	52	2 704	140 608	7.211	3.733
3	9	27	1.732	1.442	53	2 809	148 877	7.280	3.756
4	16	64	2.000	1.587	54	2 916	157 464	7.348	3.780
5	25	125	2.236	1.710	55	3 025	166 375	7.416	3.803
6	36	216	2.449	1.817	56	3 136	175 616	7.483	3.826
7	49	343	2.646	1.913	57	3 249	185 193	7.550	3.849
8	64	512	2.828	2.000	58	3 364	195 112	7.616	3.871
9	81	729	3.000	2.080	59	3 481	205 379	7.681	3.893
10	100	1 000	3.162	2.154	60	3 600	216 000	7.746	3.915
11	121	1 331	3.317	2.224	61	3 721	226 981	7.810	3.936
12	144	1 728	3.464	2.289	62	3 844	238 328	7.874	3.958
13	169	2 197	3.606	2.351	63	3 969	250 047	7.937	3.979
14	196	2 744	3.742	2.410	64	4 096	262 144	8.000	4.000
15	225	3 375	3.873	2.466	65	4 225	274 625	8.062	4.021
16	256	4 096	4.000	2.520	66	4 356	287 496	8.124	4.041
17	289	4 913	4.123	2.571	67	4 489	300 763	8.185	4.062
18	324	5 832	4.243	2.621	68	4 624	314 432	8.246	4.082
19	361	6 859	4.359	2.668	69	4 761	328 509	8.307	4.102
20	400	8 000	4.472	2.714	70	4 900	343 000	8.367	4.121
21	441	9 261	4.583	2.759	71	5 041	357 911	8.426	4.141
22	484	10 648	4.690	2.802	72	5 184	373 248	8.485	4.160
23	529	12 167	4.796	2.844	73	5 329	389 017	8.544	4.179
24	576	13 824	4.899	2.884	74	5 476	405 224	8.602	4.198
25	625	15 625	5.000	2.924	75	5 625	421 875	8.660	4.217
26	676	17 576	5.099	2.962	76	5 776	438 976	8.718	4.236
27	729	19 683	5.196	3.000	77	5 929	456 533	8.775	4.254
28	784	21 952	5.292	3.037	78	6 084	474 552	8.832	4.273
29	841	24 389	5.385	3.072	79	6 241	493 039	8.888	4.291
30	900	27 000	5.477	3.107	80	6 400	512 000	8.944	4.309
31	961	29 791	5.568	3.141	81	6 561	531 441	9.000	4.327
32	1 024	32 768	5.657	3.175	82	6 724	551 368	9.055	4.344
33	1 089	35 937	5.745	3.208	83	6 889	571 787	9.110	4.362
34	1 156	39 304	5.831	3.240	84	7 056	592 704	9.165	4.380
35	1 225	42 875	5.916	3.271	85	7 225	614 125	9.220	4.397
36	1 296	46 656	6.000	3.302	86	7 396	636 056	9.274	4.414
37	1 369	50 653	6.083	3.332	87	7 569	658 503	9.327	4.431
38	1 444	54 872	6.164	3.362	88	7 744	681 472	9.381	4.448
39	1 521	59 319	6.245	3.391	89	7 921	704 969	9.434	4.465
40	1 600	64 000	6.325	3.420	90	8 100	729 000	9.487	4.481
41	1 681	68 921	6.403	3.448	91	8 281	753 571	9.539	4.498
42	1 764	74 088	6.481	3.476	92	8 464	778 688	9.592	4.514
43	1 849	79 507	6.557	3.503	93	8 649	804 357	9.644	4.531
44	1 936	85 184	6.633	3.530	94	8 836	830 584	9.695	4.547
45	2 025	91 125	6.708	3.557	95	9 025	857 375	9.747	4.563
46	2 116	97 336	6.782	3.583	96	9 216	884 736	9.798	4.579
47	2 209	103 823	6.856	3.609	97	9 409	912 673	9.849	4.595
48	2 304	110 592	6.928	3.634	98	9 604	941 192	9.899	4.610
49	2 401	117 649	7.000	3.659	99	9 801	970 299	9.950	4.626
50	2 500	125 000	7.071	3.684	100	10 000	1 000 000	10.000	4.642

The square roots and cube roots are given to the nearest 0.001.

In the work on this page use the table on page 467.

Find the value in each of the following cases:

1. 18^2	**4.** 78^3	**7.** $\sqrt{18}$	**10.** $\sqrt{66}$	**13.** $\sqrt[3]{729}$
2. 31^2	**5.** 3.4^2	**8.** $\sqrt{78}$	**11.** $\sqrt[3]{25}$	**14.** $\sqrt{1521}$
3. 42^3	**6.** 2.7^3	**9.** $\sqrt[3]{56}$	**12.** $\sqrt{89}$	**15.** $\sqrt[3]{15{,}625}$

Remembering to move the decimal points, find the value of

16. $\sqrt{7600}$	**18.** $\sqrt{0.24}$	**20.** $\sqrt[3]{0.009}$	**22.** $\sqrt{12{,}100}$
17. $\sqrt[3]{2000}$	**19.** $\sqrt{3.61}$	**21.** $\sqrt{32.49}$	**23.** $\sqrt[3]{10.648}$

24. By thinking of 396 as 4×99, find the value of $\sqrt{396}$.

25. By thinking of 200 as 8×25, find the value of $\sqrt[3]{200}$.

As in Exs. 24 and 25, find the value of

26. $\sqrt{160}$	**28.** $\sqrt[3]{400}$	**30.** $\sqrt{3.28}$	**32.** $\sqrt[3]{0.108}$
27. $\sqrt{212}$	**29.** $\sqrt[3]{256}$	**31.** $\sqrt{3.04}$	**33.** $\sqrt[3]{0.112}$

34. Find, to the nearest 0.1 in., the side of a square which has an area of 3 sq. in.; of 17 sq. in.; of 6.76 sq. in.

35. Find, to the nearest 0.1 in., the hypotenuse of a right triangle in which the other two sides are 4.8 in. and 6.4 in.; 3.3 in. and 4.4 in.; 5.1 in. and 6.8 in.

36. In order to hold a telegraph pole vertical, a wire was stretched from a point on the pole 24 ft. above the ground to a stake 18 ft. from the foot of the pole. How long was the wire between these two points?

37. Using $r = \sqrt{\frac{7}{22} A}$, find, to the nearest 0.1, the radius of a circle which has an area of 24.64 sq. in.; of 186.34 sq. ft.

The Scientist's Use of Arithmetic

THE scientist in his laboratory makes frequent use of arithmetic, but most of his problems are too difficult for boys and girls in your grade. In the following pages you will find some interesting problems explaining the scientific principles involved in everyday things about which you already know.

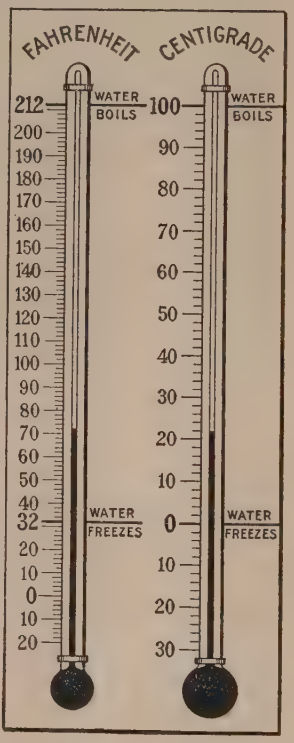
1. A laboratory test of a certain kind of fertilizer showed that it contained 2.01% nitrogen. How much nitrogen would there be in a 50-pound bag of this fertilizer?

2. The scientist often compares the weights of different substances with that of water, which weighs 62.428 lb. per cubic foot. Find the weight in ounces of 1 cu. in. of water.

3. Mercury is 13.6 times as heavy as water. What is the weight of 1 cu. ft. of mercury? of 1 cu. in. of mercury?

INSTEAD of measuring heat and cold by the common **Fahrenheit scale** used in our house and outdoor thermometers, the scientist usually measures temperature by the **centigrade scale.**

As here shown, 0° C. (0° centigrade), the freezing point of water, corresponds to 32° F. (32° Fahrenheit), and 100° C., the boiling point of water, corresponds to 212° F.



1. How many degrees are there between the freezing and boiling points of water on the Fahrenheit scale? on the centigrade scale?

2. In Ex. 1, each degree centigrade is how many degrees Fahrenheit?

3. A formula for changing from the centigrade scale to the Fahrenheit scale is $F = 1.8\,C + 32°$. Show that 0° C. = 32° F.; that 100° C. = 212° F.

4. From the formula, find the Fahrenheit reading which corresponds to 20° C.; to 38° C.; to 70° C.

5. Recorded temperatures on the earth's surface range from 74° F. below zero to 145° F. above zero. After studying the picture, find the number of degrees between these extremes.

6. At 55 ft. below the earth's surface the temperature is about 55° F., and it increases 1° for each 55 ft. thereafter. What is the temperature at a depth of 110 ft.? of 1 mi.?

1. Fresh water varies in weight according to its temperature. At 40° F. it weighs 62.428 lb. per cubic foot, and at 212° F. it weighs 59.830 lb. per cubic foot. Find the average decrease, in ounces per cubic foot, for each degree of rise in temperature.

2. Sea water, which contains salt and other minerals, weighs 64.301 lb. per cubic foot. Sea water is what per cent heavier than fresh water at 40° F. (Ex. 1)?

3. Wood floats in water because its weight per cubic foot is less than that of the water. Spruce weighs about 27 lb. per cubic foot. In fresh water at 40° F. (Ex. 1), how much weight will a spruce block 1 ft. on an edge support without sinking?

4. In Ex. 3, how much weight would the block support if it were floating in sea water (Ex. 2)?

5. From Exs. 3 and 4, try to explain why swimmers find it easier to float in sea water than in fresh water.

6. Air weighs about 1.3 oz. per cubic foot. Find the weight, in pounds, of the air in a room that is 30 ft. by 20 ft. by 10 ft.

7. The weight of the atmosphere (air) exerts an average pressure of 14.7 lb. per square inch on the earth's surface. What is the atmospheric pressure in tons per acre (43,560 sq. ft.)?

8. Balloons are often filled with hydrogen, the lightest gas known, which is about 7% as heavy as air. From Ex. 6, find the weight of the hydrogen needed to fill a balloon which has a capacity of 35,000 cu. ft.

9. Wind is only air in motion, and while you cannot see it you can feel its pressure. At 12.2 lb. per square foot, what is the total pressure exerted by a high wind on a rectangular signboard 60 ft. long and 24 ft. high?

1. An iceberg floating in sea water is about 90% under water. How far below the water does an iceberg which rises 150 ft. above the water extend?

2. Taking the weight of ice as 57.3 lb. per cubic foot and that of fresh water as 62.4 lb. per cubic foot, find what per cent, to the nearest 0.1%, the weight of ice is of that of water.

3. From Exs. 1 and 2, tell whether or not ice floats deeper in fresh water than in sea water. What would be the answer in Ex. 1 if the iceberg were floating in fresh water?

4. Water expands in freezing so that 1 cu. ft. of water makes about 1.09 cu. ft. of ice. What per cent does water expand in volume when it freezes?

5. When water is confined, as in a closed tank, its expansion in freezing exerts a pressure of about 30,000 lb. per square inch. The ordinary size of hot-water tank used in homes has about 22 sq. ft. of inside surface. What would be the total pressure exerted on the inside surface if the water should freeze? Do you see why the tank would probably burst?

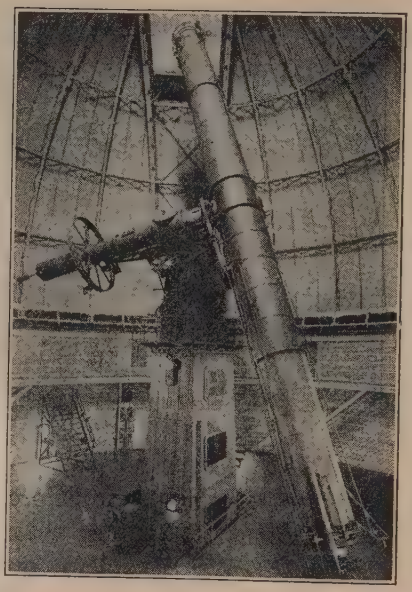
1. Did you ever notice that you can often see the steam from an engine's whistle before you hear the whistle? Sound travels about 1090 ft. per second at 32° F., and its speed increases 1 ft. per second for every 1° of rise in temperature. Find the speed of sound at 42° F.; at 56° F.; at 72° F.

2. Sound travels about 4 times as fast through water as through air. From Ex. 1, find the speed of sound through water at 32° F.; at 50° F.; at 68° F.

3. At 68° F., sound travels through iron at the rate of 16,730 ft. per second. To the nearest 0.1, this is how many times as fast as through air at the same temperature (Ex. 1)?

4. A rifle bullet is fired at a target 1 mi. away when the temperature is 62° F. (Ex. 1). If the bullet travels at an average of 2640 ft. per second, it will hit the target how many seconds before the sound of its firing is heard at the target?

1. Scientists study the sun and the stars through large telescopes. Taking the speed of light as 186,000 mi. per second and the distance from the earth to the sun as 93,000,000 mi., find how many minutes it takes light from the sun to reach the earth.



2. Taking the earth's circumference as 25,000 mi., find, to the nearest 0.01 sec., the time it takes light to travel this distance.

3. The earth is only one of many planets that revolve about the sun. The planet Neptune is 2,700,000,000 mi. from the earth. How long does it take light from Neptune to reach us?

4. At 186,000 mi. per second, how far does light travel in 1 hr.? in 1 da.? in a year of 365 da.?

5. Light that left the North Star, one of the nearer stars, 44 yr. ago is just reaching the earth. How far from the earth is the North Star?

6. Light travels so fast that for ordinary distances it is seen instantly. A boy on a hillside saw the steam from a locomotive whistling in the valley below 12 sec. before he heard the sound of the whistle. Taking the speed of sound as 1120 ft. per second, find, to the nearest 0.1 mi., how far the locomotive was from the boy.

1. Compared to the tremendous speed of light, man himself moves very slowly. A record for the 100-yard dash is $9\frac{3}{5}$ sec. To the nearest 0.1 mi., this is how many miles per hour?

2. A record made by a horse in a $\frac{1}{4}$-mile race is $21\frac{1}{4}$ sec. To the nearest 0.1 mi., this is how many miles per hour?

3. Neither a man nor a horse could maintain for long the speeds in Exs. 1 and 2, but many of man's mechanical inventions can maintain high speed for long periods. To the nearest 0.1 mi., what is the average speed in miles per hour of a railroad train that makes a run of 525 mi. in 7 hr. 50 min.?

4. In a fast short run made by a railroad train, a distance of 5 mi. was covered in 2 min. 30 sec. This represents a speed of how many miles per hour?

5. An ocean liner recently covered 778.6 mi. in a day's run. What was the average speed in miles per hour?

6. In a recent test, the speed reached by an automobile racing over a 1-mile course was 206.9 mi. per hour. At this rate, how long would it take to make a 3260-mile trip from New York to San Francisco?

7. A recent record for an actual trip from New York to San Francisco (Ex. 6) is $69\frac{1}{2}$ hr. To the nearest 0.1 mi., this is an average of how many miles per hour?

8. The greatest mechanical speed is that of a rifle bullet. To the nearest 0.1 mi., a bullet that leaves a rifle at 2700 ft. per second is traveling how many miles per hour?

9. Scientists are experimenting with rockets to be sent to the moon, which is 239,000 mi. from the earth. If such a rocket could maintain the speed of the bullet in Ex. 8, how long would it take it to reach the moon?

SUPPOSE that Jack, the boy at the right in this picture, weighs 90 lb., and Tom, the boy at the left, weighs 75 lb. As you probably discovered long ago in playing seesaw, Jack, **the heavier boy, must move nearer the fulcrum** (the point of support) if he wants to balance Tom.

© Keystone View Co.

Using "distance" to mean "the distance from the fulcrum," the scientific explanation of this is that the seesaw will just balance when

Jack's weight × his distance = Tom's weight × his distance.

That is, if Tom is sitting 6 ft. from the fulcrum, to find the distance d at which Jack should sit to balance him, you have

$$90 \times d = 75 \times 6,$$

from which, as here shown, d is 5 ft.

$$90 \times d = 75 \times 6$$
$$90\,d = 450$$
$$d = 5$$

In each of these cases, find the missing distance:

	First Boy	Distance	Second Boy	Distance
1.	90 lb.	_____ ft.	80 lb.	9 ft.
2.	100 lb.	_____ ft.	90 lb.	5 ft.
3.	72 lb.	4 ft.	48 lb.	_____ ft.
4.	100 lb.	6 ft.	96 lb.	_____ ft.

PROBABLY you have often seen workmen move large weights by using an iron bar or a piece of timber as a lever. The seesaw on the opposite page is a kind of lever.

The scientific explanation of the lever is the same as for the seesaw. That is, using "distance," as before, to mean "the distance from the fulcrum," the force that the boy in the pictures must exert to balance the weight W can be found from

Force × its distance = weight × its distance.

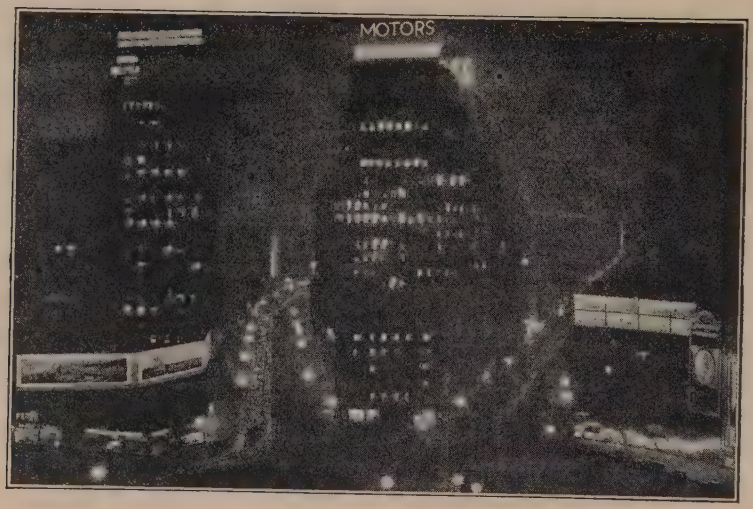
After the boy gets the weight balanced, it will require only a little more force to lift it.

1. Suppose that, in the left-hand picture, W is a weight of 180 lb. at a distance of 3 ft. from the fulcrum F and that the boy's hands are 6 ft. from F. Letting f represent the force, then $f \times 6 = 180 \times 3$, or $6f = 540$. What downward force in pounds will the boy have to exert to balance W?

2. If, in the right-hand picture, W is a weight of 180 lb. at a distance of 3 ft. from F, and the boy's hands are 9 ft. from F, what upward force will he have to exert to balance W?

3. What force will have to be applied 6 ft. from the fulcrum F to balance a weight of 240 lb. at a distance of 2 ft. from F? at a distance of 4 ft. from F?

4. How large a weight 6 in. from the fulcrum can be balanced by a force of 60 lb. applied 4 ft. from the fulcrum?



1. For 20,880 electric signs in one part of New York City it takes 1,309,918 lamps. What is the average number of lamps used per sign?

2. The light from an electric lamp comes from the tiny filament (thread) of metal that is heated by the electric current. The filaments are usually made of tungsten, which has a melting point of about 6100° F. To the nearest 0.1, this is how many times the melting point of lead, 621° F.?

3. Electric power is measured in watts, and 746 watts are equivalent to 1 H. P. (horse power). The common size of lamp used in homes requires 50 watts of electricity per hour. To the nearest 0.1%, the electric power required to run such a lamp is what per cent of 1 H. P.?

4. In measuring the power supplied by electric generators, the kilowatt (1000 watts) is generally used. To the nearest 0.01, a kilowatt is equivalent to how many horse power?

1. Snow is approximately $\frac{1}{8}$ as heavy as water. A snowfall of 6 in. is equivalent to how large a rainfall?

2. When water turns into steam, the volume of the steam is about 1600 times the volume of the water. How many cubic feet of steam will 1 gal. (231 cu. in.) of water produce?

3. For ordinary purposes it is sufficiently accurate and more convenient to take the weight of water as $62\frac{1}{2}$ lb. per cubic foot. A more accurate value is 62.428 lb. How much difference does it make in computing at $62\frac{1}{2}$ lb. the weight of water in a rectangular tank that is 6 ft. long, 4 ft. wide, and filled to a depth of $3\frac{1}{2}$ ft.?

4. Nitrogen gas is 96.7% as heavy as air, and hydrogen gas is 6.9% as heavy as air. To the nearest 0.1, nitrogen is how many times as heavy as hydrogen?

5. Mercury is used in thermometers because it is liquid at ordinary temperatures and does not solidify until 39° F. below zero is reached. This is how many degrees less than the freezing point of water, 32° F. above zero?

6. The planet Mercury takes 88 da. to complete its circuit of the sun, while the planet Venus takes 225 da. Taking the average speed of Mercury as 29 mi. per second and that of Venus as 21 mi. per second, find the distance that each of these planets travels round the sun.

7. What is the speed in feet per second of a gale that is blowing at the rate of 75 mi. per hour?

8. At approximately 32° F., the speed of sound in air is 1090 ft. per second, and in sea water at the same temperature the speed is 4767 ft. per second. To the nearest 0.1, the speed of sound in sea water is how many times that in air?

9. Ocean depths are often measured by finding the time it takes sound to travel to the bottom and be reflected back again to the vessel from which it is sent. Taking the speed of sound in sea water as 4767 ft. per second, how deep is the water at a point where it takes sound 4.6 sec. to travel to the bottom of the ocean and back again?

10. At ordinary distances a flash of lightning is seen instantly. Taking the speed of sound in a storm as 1120 ft. per second, how far away, to the nearest 0.1 mi., is a flash of lightning when the thunder is not heard until 8.2 sec. after the lightning is seen?

11. Aviators have found that in the first 2000 ft. the temperature of the air decreases about 1° for each 200 ft. of elevation, then 1° for each 250 ft. up to 4000 ft., then 1° for each 300 ft. up to 1 mi., and then 1° for each 350 ft. How much will the temperature drop in climbing 6000 ft.?

12. In Ex. 11, on a day when the temperature on the ground is 65° F., what temperature will an aviator find at a height of 7500 ft.? of 10,000 ft.?

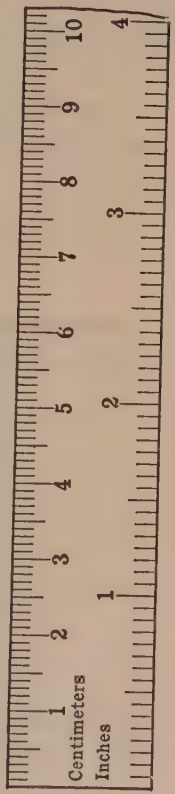
13. Since the pressure of the atmosphere (air) is caused by its weight, the higher you go the less pressure there is. At sea level the pressure is about 14.7 lb. per square inch, and at a height of 10,500 ft. it is only $\frac{2}{3}$ as much. What is the total pressure at this height on the upper face of an airplane wing that is an approximate rectangle 56 ft. by $14\frac{1}{2}$ ft.?

14. Water pressure, like air pressure, is due to the weight of the water. Water exerts a pressure of 0.434 lb. per square inch for each foot of depth. What would be the pressure in pounds per square inch on the base of a water tank in which the water stands at a depth of 52 ft. 6 in.?

Metric Units

THE **metric system of measures** is used all over the world in scientific work, and in many industries in this country. The unit of length in this system is the **meter** (about 39.37 in.). Since the system is a decimal one, like our system of money, it is easy to change from one unit to another. This table shows how the important measures of length are based on the meter:

1 millimeter (mm.) = 0.001 meter (m.)
1 centimeter (cm.) = 0.01 meter
1 kilometer (km.) = 1000 meters



The unit of weight in the metric system is the **gram** (about 0.035 oz.), but for ordinary weighing the **kilogram (kg.)**, which is 1000 grams or about 2.2 lb., is more often used.

In measuring capacity, the unit used is the **liter (l.)**, which is about 1 qt., liquid.

As you can see, since the measures are similarly named, about all that you need to learn in the metric system are the prefixes *milli-*, meaning "**thousandth**," *centi-*, meaning "**hundredth**," and *kilo-*, meaning "**thousand**."

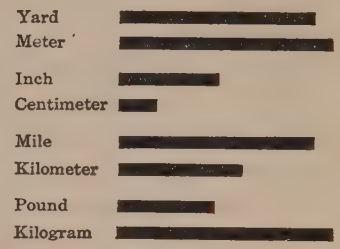
Find the missing numbers:

1. 7.6 km. = —— m. = —— cm.

2. 825 cm. = —— mm. = —— m.; 1500 m. = —— km.

3. A gram is what part of a kilogram? How many grams are there in 2.2 kg.? in 5.6 kg.? in 100 kg.?

THIS diagram will help you to compare the most important measures in the metric system with the corresponding measures in our common system. **In each pair, the two bars are drawn to the same scale,** but they do not, of course, represent the actual sizes of the different measures.



Study the diagram in connection with this table of approximate equivalents:

1 m. = 1.1 yd.	1 km. = 0.6 mi.
1 cm. = 0.4 in.	1 kg. = 2.2 lb.

Find the numbers that belong in the blank spaces:

1. 1 mm. = —— cm.
2. 1 km. = —— m.
3. 1 m. = —— km.
4. 1 cm. = 10 mm.
5. 1 m. = 100 cm.
6. 1 m. = 1000 mm.
7. 5 cm. = 2 in.
8. 2 kg. = 4.4 lb.
9. 2 km. = 2 mi.
10. 6.5 cm. = —— in.
11. 5 m. = —— yd.
12. 40 km. = —— mi.

13. A 10-kilometer race in the Olympic Games is equivalent to how many miles?

14. The weight of the largest meteor on record is 33,182 kg. This is about how many tons (2000 lb.)?

15. In Europe, where the metric system is used, the speedometers of automobiles register speed in kilometers per hour. What is the approximate speed in miles per hour of a car that is going 50 km. per hour?

16. A European dirigible balloon made a trip to New York by a route that was 8500 km. long. Express the length of this trip in miles.

17. On some roads in Europe there are kilometer posts like our mileposts. If a car passes a kilometer post every minute, what is its speed in kilometers per hour? in miles per hour?

18. A metal meter stick, which was accurate at 26.8° C., was found to measure 99.981 cm. at 10° C. and 100.015 cm. at 40° C. What was the total variation between 10° and 40°?

19. The width of one of the new "talking" moving-picture films is 70 mm. What is its approximate width in inches?

20. A liter is the volume of a cube that is 0.1 m. on an edge. What part of a cubic meter is there in such a cube?

21. From Ex. 20, how many liters are there in 1 cubic meter?

22. What is the length of each edge of a cube that contains 1000 cubic centimeters?

23. In Ex. 22, find the volume of the cube in cubic meters.

24. How many cubic centimeters are there in a cubic meter?

25. A cubic centimeter of water weighs 1 gram. From Ex. 24, find the weight in kilograms of a cubic meter of water.

26. In Ex. 25, find the weight in pounds of the water. To how many cubic feet is a cubic meter equivalent?

27. Copper is 8.9 times as heavy as water (see Ex. 25). Find the weight in kilograms of a cube of solid copper that is 20 cm. on an edge. Taking 62.428 lb. as the weight of 1 cu. ft. of water, find the weight in pounds of a cube of solid copper that is 8 in. on an edge. Which is the easier computation to make, and why is it easier?

1. The distance from New York to Chicago by one route is 980 mi. Express this distance in kilometers.

2. In a swimming race, the winner covered a distance of 100 m. in 57.4 sec. Giving the answer to the nearest 0.1 yd., express his rate in yards per second.

3. What is the height in feet and inches and the weight in pounds of a boy who is 145 cm. tall and weighs 42.5 kg.?

4. Find, to the nearest 0.01, the number of square meters in a rectangle 240 cm. long and 120 cm. wide.

5. Find, to the nearest 0.01, the number of square feet in a rectangle 2 ft. 5 in. long and 1 ft. 2 in. wide.

6. Since 1 liter is equal to 1000 cubic centimeters, what is the capacity in liters of a rectangular tank 120 cm. long, 80 cm. wide, and 90 cm. deep?

7. At $7\frac{1}{2}$ gal. to the cubic foot, what is the capacity in gallons of a rectangular tank 50 in. long, 30 in. wide, and 40 in. deep?

Find the numbers that belong in the blank spaces:

8. 150 m. = —— yd.
9. 150 m. = —— ft.
10. 250 yd. = —— m.
11. 250 ft. = —— m.
12. 3 mi. = —— km.
13. 30 km. = —— mi.
14. 2500 m. = —— km.
15. 2 kg. = —— lb.
16. 1 lb. = —— kg.
17. $\frac{1}{2}$ lb. = —— kg.
18. 100 kg. = —— lb.
19. 100 lb. = —— kg.
20. 1000 kg. = —— lb.
21. 2000 lb. = —— kg.

See if you can do all these additions correctly:

1.	2.	3.	4.
$97.23	$89.92	$33.48	$57.07
21.20	10.27	57.69	43.18
75.97	97.83	85.97	90.77
22.64	69.93	90.42	65.61
80.15	98.81	46.68	56.58
68.37	47.56	45.59	44.26

See if you can do all these subtractions correctly:

5.	6.	7.	8.
$98.43	$93.58	$66.14	$84.50
68.06	57.99	48.68	79.70
9.	**10.**	**11.**	**12.**
812,221	511,100	845,598	823,489
502,345	412,340	797,989	679,878

See if you can do all these multiplications correctly:

13.	14.	15.	16.
94,760	70,496	64,097	15,283
172	358	4690	134
17.	**18.**	**19.**	**20.**
58,235	83,152	97,853	89,567
756	2890	769	408
21.	**22.**	**23.**	**24.**
56,028	37,254	16,305	59,360
4007	8605	9007	8040

See if you can do all these divisions correctly:

25. $79\overline{)403{,}532}$ **28.** $65\overline{)700{,}050}$ **31.** $9.8\overline{)444.528}$

26. $86\overline{)573{,}792}$ **29.** $89\overline{)763{,}442}$ **32.** $0.07\overline{)392.7224}$

27. $91\overline{)637{,}546}$ **30.** $75\overline{)300{,}000}$ **33.** $8.01\overline{)72{,}153.279}$

See if you can do all these examples correctly:

1. $\frac{7}{8}+\frac{5}{8}$
2. $\frac{7}{8}+\frac{3}{4}$
3. $\frac{3}{4}-\frac{1}{2}$
4. $\frac{15}{16}-\frac{5}{8}$
5. $\frac{3}{8}\times\frac{1}{2}$
6. $\frac{5}{8}\div\frac{1}{2}$
7. $\frac{1}{4}\div\frac{7}{8}$
8. $\frac{3}{4}\div\frac{3}{8}$
9. $3\frac{1}{8}-1\frac{3}{4}$
10. $2\frac{7}{8}+3\frac{1}{2}$
11. $5\frac{1}{16}-\frac{3}{4}$
12. $2\frac{1}{2}-\frac{2}{3}$
13. $9\frac{1}{2}\div 2\frac{3}{8}$
14. $2\frac{3}{4}\times 1\frac{1}{2}$
15. $5\frac{1}{4}\div\frac{7}{8}$
16. $3\frac{1}{4}\times 6\frac{7}{8}$

Add, subtract, multiply, or divide, as indicated:

17. $4.23+5.98$
18. $6.01-2.37$
19. 48×65.03
20. 5.7×9.84
21. 3.07×80.96
22. 0.09×753.02
23. 0.007×54.68
24. 8.05×964.03
25. $1826\div 20.75$
26. $4483.836\div 567$
27. $40.6614\div 5.07$
28. $795.375\div 90.9$

Find each of these per cents:

29. 25% of \$728.40
30. $12\frac{1}{2}$% of \$856.80
31. $33\frac{1}{3}$% of \$884.10
32. $37\frac{1}{2}$% of \$1280.40
33. 110% of \$1256.50
34. 1.01% of \$58,765
35. 0.07% of \$125,000
36. 28.2% of \$10,856.50

Find the missing numbers:

37. 17 ft. 6 in. = —— in.
38. 1 yd. 27 in. = —— in.
39. $38\frac{1}{2}$ yd. = —— ft.
40. $14\frac{1}{2}$ bu. = —— pk.
41. $16\frac{3}{4}$ gal. = —— qt.
42. 3 lb. 14 oz. = —— oz.
43. $6\frac{1}{2}$% of \$780 = \$——
44. \$82 = 25% of \$——
45. \$75 = ——% of \$300
46. \$874 = 5% of \$——
47. \$6.44 = ——% of \$80.50
48. 5% of 25% of \$40 = \$——

1. The Jones family uses an average of $2\frac{1}{2}$ qt. of milk per day. How many gallons does the family use per year (365 da.)?

2. An increase in wages from \$1.20 per hour to \$1.40 per hour is what per cent of increase? A decrease from \$1.40 to \$1.20 is what per cent of decrease?

3. At \$3.50 per square yard, find the cost of a cement sidewalk 90 ft. long and 5 ft. 6 in. wide.

4. On a sale amounting to \$908.50 a salesman received a commission of $6\frac{1}{2}\%$. How much did he receive?

5. At 42 cu. ft. to the ton, how many tons of soft coal will it take to fill a rectangular bin $8\frac{1}{2}$ ft. long and 7 ft. wide to a depth of 6 ft.?

6. In making some soap a housekeeper used 3 qt. of fat, 3 qt. of water, and 1 pt. of lye. Each of these was what per cent of the whole mixture?

7. What per cent of the marked price do you save when you buy for \$27.20 a suit that is marked \$32?

8. What was the average monthly rainfall in a place where the rainfall by months last year was as follows: 0.8 in., 1.2 in., 1.8 in., 2.8 in., 3.5 in., 2.6 in., 2.0 in., 0.5 in., 1.4 in., 2.6 in., 3.5 in., 1.5 in.?

9. What is the difference between a discount of 42% on a bill amounting to \$200 and a discount of 40% plus an extra discount of 2% for cash?

10. A man bought some land for \$3750 and sold it at a profit of 28% on what it cost. For how much did he sell it?

11. A merchant borrowed \$7500 for 60 da. at 5%. How much interest did he have to pay?

1. In what operation is the answer called "the sum"? "the product"? "the difference"? "the quotient"?

2. \$18.50 is $\frac{1}{5}$ of what number? 5% of what number?

3. When you know the amount of the commission that a salesman earns and the amount of the sale, how can you find the rate of commission paid him?

4. Interest at 6% for 60 da. is equivalent to what per cent of the principal? What short method would you use in finding interest for 30 da. at 6%?

5. In calling a fraction "an indicated division," which term is the dividend? which is the divisor?

Give the meaning of each of these terms:

6. Decimal. **7.** Average. **8.** Perimeter. **9.** Per cent. **10.** Dimensions. **11.** Numerator. **12.** Mixed number. **13.** Proper fraction. **14.** Improper fraction.

15. How do you find a common denominator of two or more fractions? What common denominator would you use in adding $\frac{7}{8}$ and $\frac{5}{6}$? Could you have used a smaller common denominator?

16. Complete this statement: In a curve-line graph an increase is shown by a ——— in the curve and a decrease by a ——— in the curve.

17. From a table of square roots a pupil found that the square root of 2455 is 49.55. From this, how can you find the square root of 24.55? What is it?

18. If you know the amount of a man's tax bill and the value at which his property is assessed, how can you find the tax rate in dollars per \$1000?

TABLES FOR REFERENCE

Length

12 inches (in.) = 1 foot (ft.)
3 feet or 36 inches = 1 yard (yd.)
$5\frac{1}{2}$ yards or $16\frac{1}{2}$ feet = 1 rod (rd.)
320 rods or 5280 feet = 1 mile (mi.)

Square Measure

144 square inches (sq. in.) = 1 square foot (sq. ft.)
9 square feet = 1 square yard (sq. yd.)
$30\frac{1}{4}$ square yards = 1 square rod (sq. rd.)
160 square rods = 1 acre (A.)
640 acres = 1 square mile (sq. mi.)

Cubic Measure

1728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.)
27 cubic feet = 1 cubic yard (cu. yd.)

Weight

16 ounces (oz.) = 1 pound (lb.)
2000 pounds = 1 ton (T.)

Liquid Measure

2 pints (pt.) = 1 quart (qt.)
4 quarts = 1 gallon (gal.)

Dry Measure

2 pints (pt.) = 1 quart (qt.)
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)

Time

60 seconds (sec.) = 1 minute (min.)
60 minutes = 1 hour (hr.)
24 hours = 1 day (da.)
7 days = 1 week (wk.)
12 months (mo.) or 365 days = 1 year (yr.)

In a leap year (366 da.), February has 29 da. instead of the usual 28 da. April, June, September, and November always have 30 da. each, and the other months have 31 da.

In computing interest, a year is generally taken as 12 mo. of 30 da. each, or 360 da. in all.

Angles and Arcs

60 seconds (″) = 1 minute (′)
60 minutes = 1 degree (°)

There are 360° in a circle and 90° in a right angle.

Practical Equivalents

1 bu. contains $1\frac{1}{4}$ cu. ft. or 2150 cu. in.
1 bbl. (barrel) contains 4.2 cu. ft. or $31\frac{1}{2}$ gal.
1 gal. contains 231 cu. in.
1 cu. ft. contains $7\frac{1}{2}$ gal.
1 cu. ft. of water weighs $62\frac{1}{2}$ lb.
1 cd. (cord) of 4-foot wood occupies 128 cu. ft.
1 T. of hard coal occupies 35 cu. ft.
1 T. of soft coal occupies 42 cu. ft.
1 A. contains 43,560 sq. ft.
1 meter (m.) = 1.1 yd. or 39.37 in.
1 centimeter (cm.) = 0.4 in.
1 kilometer (km.) = $\frac{5}{8}$ mi. or 0.62 mi.
1 kilogram (kg.) = 2.2 lb.

These are in general only approximations, but they give results that are sufficiently close for ordinary computations.

Surveyors' Measures

In city surveys, lengths are usually measured in feet and decimals of a foot (usually to the nearest 0.01 ft.), and areas are computed in square feet. Many of the older surveys — particularly those in less thickly-settled portions of the country — were made with the **surveyors' chain, which is 66 ft. long and is divided into 100 links.**

In changing to feet measurements given in chains and links, the following relations are useful:

1 chain (ch.) = 66 ft. = 4 rd.
1 link (li.) = 0.01 ch. = 0.66 ft. = 7.92 in.
1 mi. = 5280 ft. = 320 rd. = 80 ch.

For example, in changing 42.30 ch., which means 42 ch. 30 li., to feet, the computation is as follows:

$42.30 \times 66 = 2791.80$. 2791.80 ft. *Ans.*

Since the inch is seldom used in surveying, there is rarely any occasion to change links to inches.

The practical convenience of the chain is seen in the computation of areas, as shown in the following table:

1 sq. ch. = 16 sq. rd. = 0.1 A.
1 A. = 160 sq. rd. = 10 sq. ch.
1 sq. mi. = 640 A. = 6400 sq. ch.

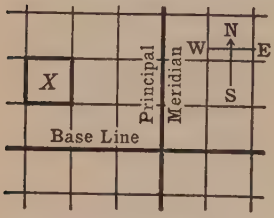
For example, in finding the area of a field that is 18.25 ch. long and 12.40 ch. wide, the area in acres may be found as follows:

$18.25 \times 12.40 = 226.30$ (sq. ch.). 22.63 A. *Ans.*

That is, since 1 sq. ch. = 0.1 A., it is seen at once from the area in square chains that the area of the field is 22.63 A.

Townships and Sections

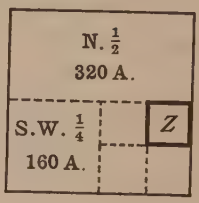
In some parts of the country, tracts of land are laid out in regular square blocks, as shown in the following figures:



Tract of land

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	Y	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Township *X*



Section 21

As shown in the first figure, an east-and-west line through the tract is chosen as the **base line** and a north-and-south line as the **principal meridian.** At intervals of 6 mi., lines are run parallel to the base line and to the principal meridian, thus dividing the land into **townships,** 6 mi. square.

1 township (T.) = 36 sq. mi.

The north-and-south rows are called **ranges.** The township *X* is described as **T. 2 N., R. 3 W.**; that is, it is the **second township north** of the base line in the **third range west** of the meridian. Each township is divided into **numbered sections** by lines 1 mi. apart, as shown in the second figure.

1 section (Sec.) = 1 sq. mi. = 640 A.

A section may be divided into **quarter sections (160 A.), half sections (320 A.),** or in other ways, as shown in the third figure. The piece marked *Z* in this figure would be described as "the N. E. ¼ of S. E. ¼, Sec. 21, T. 2 N., R. 3 W.," which means "the northeast quarter of the southeast quarter of Section 21, second township north, third range west."

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Page 1. 1. $1.20. 2. 25¢. 3. $2.24. 4. $2.05. 5. $5.25.

Page 2. 1. 36,924. 2. 26,643. 3. $227.41. 4. $229.11. 5. 3588. 6. 38,572. 7. 17,155.2. 8. 5 ft. 1 in. 9. 9 bu. 1 pk. 10. 7 hr. 42 min. 14 sec. 11. $24.91. 12. $4.75. 13. $12.15. 14. 5 sq. yd. 15. 12 lb.

Page 3. 1. 2428. 2. 1473. 3. $24.40. 4. $13.16. 5. $16.60. 6. 173.2. 7. 22.97. 8. 4983. 9. 1.123. 10. 0.582. 11. 1353. 12. 964. 13. 298.7. 14. 765. 15. 379.8. 16. 2604. 17. 987. 18. 5899. 19. 25.98. 20. 6.065. 21. $2.38. 22. $6.91. 23. $8.27. 24. $9.62. 25. $3.85. 26. $9.46. 27. $0.84. 28. $7.91. 29. $9.13. 30. $5.19. 31. 7 oz. 32. 2 T. 500 lb. 33. 1 gal. 7 pt. 34. 18 in. 35. 6 yr. 2 mo. 4 da. 36. 5 yr. 5 mo. 2 da.

Page 4. 1. $37.40. 2. $24.75. 3. $5. 4. $66. 5. $38.50. 6. $19.80. 7. $13.20; $83.60.

Page 5. 1. 25; 32; 0; 24; 27; 28; 24; 0; 24; 27. 2. 42; 64; 49; 45; 72; 40; 54; 56; 45; 63. 3. 63; 48; 54; 56; 40; 72; 42; 81; 48; 36. 4. 15; 30; 35; 36; 0; 32; 35; 36; 30; 28. 5. 1,408,844. 6. 2,438,060. 7. $39,218.11. 8. $11,459.40. 9. 1,160,430. 10. 4,848,920. 11. $38,139.64. 12. $51,984.10. 13. 2,773,181. 14. 4,008,696. 15. $54,486.12. 16. $35,957.88. 17. 3,453,395. 18. 2,484,550. 19. $34,993.75. 20. $58,081.66.

Page 6. 1. $512.64. 2. 512.64 mi. 3. 72¢. 4. $19.48. 9. 0.225. 10. 0.0435. 11. 0.004. 12. 0.9. 13. 0.048. 14. 0.8. 15. 0.0016. 16. 0.96. 17. 0.0054. 18. 2847.95. 19. 5256.4. 20. 9.19366. 21. 218.4. 22. 0.61676. 23. 278.6768. 24. 1.42038. 25. 80,874.3.

Page 7. 1. $5.27. 2. $274.04. 3. 72¢. 4. $32.76. 5. $202.80; $71.24 less. 6. $14.48. 7. $757.12.

Page 8. 1. 7; 8; 8; 5; 8; 8. 2. 7; 6; 7; 6; 9; 9. 3. 9; 7; 6; 8; 6; 7. 4. 9; 9; 3; 5; 5; 7. 5. 4; 5; 8; 9; 6; 4. 6. 147. 7. 95. 8. 84. 9. 73. 10. 24. 11. 68. 12. 49. 13. $210\frac{1}{4}$. 14. $44\frac{1}{8}$. 15. $100\frac{1}{7}$. 16. 302. 17. 208. 18. 64. 19. 89. 20. 44. 21. $161\frac{1}{8}$. 22. 64. 23. $18\frac{1}{8}$. 24. $79\frac{43}{87}$. 25. 36. 26. 206. 27. 125. 28. $7.80. 29. $1.78. 30. $3.09. 31. $3.08. 32. $9.75. 33. $9.08. 34. $1.68. 35. 11¢.

Page 11. 1. $8\frac{3}{8}$. 2. $4\frac{5}{8}$ yd. 3. $3\frac{3}{4}$. 4. 7. 5. $1\frac{3}{8}$. 6. $1\frac{3}{8}$. 7. $1\frac{1}{2}$. 8. $7\frac{1}{4}$ ft. 9. $14\frac{1}{4}$ lb. 10. $\frac{1}{4}$. 11. $\frac{1}{4}$. 12. $1\frac{1}{8}$. 13. $3\frac{3}{4}$ ft. 14. $16\frac{2}{3}$ yd. 15. $\frac{1}{8}$. 16. $\frac{3}{8}$. 17. $\frac{15}{32}$. 18. $2\frac{1}{4}$. 19. 4. 20. 18. 21. $6\frac{1}{4}$. 22. $10\frac{25}{32}$. 23. $51. 24. 2. 25. $\frac{1}{2}$. 26. 1. 27. $\frac{1}{8}$. 28. 6. 29. 2. 30. 2. 31. $\frac{1}{2}$. 32. 4. 33. 2. 34. 10. 35. 2.

Page 12. 1. $40. 2. $3. 3. $150; $1650. 4. $4607.50. 5. $10. 6. $10. 7. $68. 8. $75. 9. $56. 10. $130. 11. $612. 12. $1248. 13. $91. 14. $23. 15. $489. 16. $4324.

Page 13. 1. $60. 2. $11.60. 3. $437.50. 4. $48. 5. $4150. 6. $31.80.

Page 14. 1. $240; $19.20. 2. $15.84; $21.84. 3. $507.50. 4. $15,680. 5. $3223.22. 6. The sale at $7\frac{1}{2}\%$. 7. $24.75. 8. $51.20. 9. $93.75. 10. $200. 11. $400. 12. $1200. 13. $531.25. 14. $525. 15. $1125. 16. $255.10. 17. $337.70. 18. $963.15.

Page 15. 1. $1560, $1520, $1500, $1600; fourth. 2. $1872. 3. $2392. 4. $1584. 5. $9.21. 6. $600. 7. $1025. 8. $6200.

Page 16. 1. $624. 2. $936. 3. $1300. 4. $520. 5. $3693. 6. $6040. 7. $192.31; $180.31.

Page 17. 1. $1040. 2. $1144. 3. $1258.40; $24.20. 4. $110; $25.38. 5. $125; $28.85. 6. $2100; $175. 7. $229.17; $52.88. 8. $32.88.

Page 18. 1. $8.25. 2. $4.15. 3. $170. 4. 25¢. 5. $4.80. 6. 44¢.

Page 19. 1. $475. 2. $2700. 3. Regular salary; $300. 4. Professional work; $400. 5. Regular salary; $300. 6. Regular salary; $140. 7. Professional work; $1300. 8. Professional work; $1100. 9. Professional work; $1080.

Page 20. 1. $4.80; $3.60; $4.50; $3.90; $4.35; $2.40; $23.55. 2. 42; $26.25; yes. 3. 2; $2.40; $36. 4. $38.50. 5. $41.25. 6. Hours worked: $39\frac{1}{4}$, 42, 44, 44, $51\frac{1}{2}$; wages due: $23.55, $26.25, $36, $38.50, $41.25; totals: 40, 39, $38\frac{3}{4}$, 38, 39, 26, $220\frac{3}{4}$, $165.55; $165.55.

Page 21. 1. 200. 2. $5\frac{2}{3}$ hr. 3. 13 lb. 2 oz. 4. 328.08. 5. $10.26. 6. 20¢. 7. 228. 8. $62\frac{1}{2}$¢. 9. $41\frac{3}{4}$. 10. 15,000.

Page 22. 1. 8883. 2. 30,000. 3. 356,736. 4. 283,360. 5. 142,042. 6. 2026.4. 7. 329.82. 8. 58.824. 9. 14.5305. 10. 39,168. 11. 201. 12. 120. 13. 35. 14. 63. 15. 0.89. 16. 0.109. 17. 0.79. 18. 0.425. 19. $1\frac{1}{8}$. 20. $\frac{1}{8}$. 21. $\frac{5}{16}$. 22. $1\frac{1}{4}$. 23. $6\frac{5}{8}$. 24. $\frac{7}{8}$. 25. $10\frac{25}{32}$. 26. $\frac{23}{30}$. 27. $\frac{3}{17}$. 28. 2. 29. $\frac{1}{2}$. 30. 1. 31. 0.50. 32. 25%. 33. 0.20; 20%. 34. $\frac{1}{10}$; 0.10. 35. $\frac{2}{5}$; 40%. 36. $33\frac{1}{3}\%$. 37. $\frac{2}{3}$; $0.66\frac{2}{3}$. 38. $0.16\frac{2}{3}$; $16\frac{2}{3}\%$. 39. $\frac{3}{8}$; $37\frac{1}{2}\%$. 40. 1; 1.00.

Page 23. 1. 15; 75. 2. 40. 3. 80. 4. $40.

Page 24. 9. 0.5. 10. 30. 11. 400. 12. 0.3. 13. 1.2. 14. 5. 15. 0.12. 16. 0.005. 17. 300. 18. 900. 19. 20. 20. 40. 21. 6. 22. 0.003. 23. 227. 24. 2000. 25. $\frac{4}{5}$. 26. 95. 27. $8\frac{5}{8}$. 28. $1\frac{7}{23}$. 29. $6\frac{1}{5}$. 30. $2\frac{3}{8}$. 31. 0. 32. $3\frac{1}{3}$. 33. 20. 34. 19.7. 35. 11.54. 36. 14.6064. 37. $42.76. 38. $55.29. 39. 34¢. 40. $158. 41. $22.10. 42. $1.31. 43. 4¢. 44. $28.70. 45. $47.10.

Page 25. 1. $8.30; $5.05. 3. Balance, $10.05.

Page 26. 1. $780. 2. $900; $17.31. 3. $56.25. 4. $360. 5. $300. 6. $150. 7. $17.50. 8. $300. 9. $145.30. 10. House, $1092; food, $1260; clothing, $504; advancement, $420; miscellaneous, $294; health, $210; savings, $420. 11. $7.13. 12. $7.36. 13. $32.40.

Page 28. 1. $6.08. 2. $7.36. 3. 3; 24¢. 4. $\frac{3}{5}$¢. 5. $1.68.

Page 29. 1. $3.36. 2. $6.24. 3. $3.43. 4. 1900 cu. ft.; $2.28. 5. 3500 cu. ft.; $3.85. 6. 2500 cu. ft.; $3.50. 7. 2500 cu. ft.; $3.13.

Page 30. 1. $540. 2. $78. 3. $210. 4. $330. 5. $408. 6. $810. 7. $1020. 8. $75. 9. $205. 10. $10,000. 11. $1.90; $19. 12. $143. 13. $210.80. 14. $42. 15. $69. 16. $288. 17. $1269. 18. $1180. 19. $20.60.

Page 32. 1. $13.12. 2. 60¢. 3. $1.40. 4. 328,500 millions of gallons.

Page 33. 1. 14¢. 2. 39¢. 3. 18¢. 4. 9¢. 5. 28¢. 6. 84¢.

Page 34. 1. 14¢. 2. 12¢. 3. Lost; 25¢. 5. 60¢. 6. 80¢. 7. 40¢. 8. 60¢. 9. $1.11. 10. $2.05.

Page 35. 1. $1.30; $5.20. 2. $1.65; $14.85. 3. $7; $35. 4. $1.90; $7.60. 5. $5.50; $49.50. 6. $16; $80. 7. $1.85; $16.65. 8. $9.50; $47.50.

Page 37. 1. $40. 2. $40. 6. $4.59. 7. $13.20. 8. Second; 20¢. 9. $14.40. 10. $19. 11. $32. 12. $61.50. 13. $117.50. 14. $2. 15. $5.58. 16. $17.02. 17. $1062.50. 18. $2250.

Page 38. 1. $8.35; $33.15. 2. $5.20. 3. First; 20¢. 4. $8.23. 5. $8.33.

Page 40. 1. $22.65. 2. $7.88. 3. $20.11. 4. $11.66. 5. $7.90. 6. $84.20. 7. $7.68. 8. $44.75.

Page 41. 2. $3.85. 3. $6.88. 5. $16.88. 6. $5.63.

Page 42. 1. $60. 3. $8. 4. $50. 5. $375.50.

Page 43. 1. $10. 2. $18. 3. $15. 4. $80. 5. $175. 6. $28.20. 7. $70. 8. $50. 9. $360. 10. $432. 11. $160. 12. $290. 13. 75¢. 14. $4.40. 15. $4. 16. $4.35. 17. $67.20. 18. $3.20. 19. $2.40. 20. $24. 21. $20.50. 22. $35.36. 23. $51.98. 24. $58.14. 25. $498.96. 26. 12.5874. 27. 22.8312. 28. 386.595. 29. 1.70396. 30. 3.34425.

Page 44. 1. $1\frac{1}{4}$. 2. $1\frac{1}{2}$. 3. $\frac{7}{8}$. 4. $1\frac{1}{2}$. 5. $8\frac{3}{5}$. 6. $8\frac{1}{3}$. 7. $\frac{5}{6}$. 8. $1\frac{1}{12}$. 9. $1\frac{1}{12}$. 10. $\frac{9}{10}$. 11. $4\frac{1}{12}$. 12. $6\frac{3}{10}$. 13. $\frac{3}{8}$. 14. $\frac{3}{8}$. 15. $\frac{1}{4}$. 16. $\frac{3}{8}$. 17. $1\frac{2}{3}$. 18. $3\frac{5}{8}$. 19. $\frac{1}{6}$. 20. $\frac{1}{6}$. 21. $\frac{5}{12}$. 22. $\frac{5}{24}$. 23. $2\frac{13}{20}$. 24. $5\frac{1}{12}$. 25. 40. 26. $180. 27. $2\frac{1}{32}$. 28. $\frac{1}{3}$. 29. 24. 30. $\frac{9}{20}$. 31. 20. 32. $\frac{1}{20}$. 33. 20. 34. $8\frac{1}{3}$. 35. $1\frac{9}{14}$. 36. $5\frac{1}{10}$.

Page 45. 1. $75. 2. $108. 3. $108. 4. $108. 5. $168. 6. $15. 7. $15. 8. $15. 9. $21.50. 10. $13.75. 11. $25.50. 12. $46. 13. $48.75.

Page 46. 1. $12. 2. $10. 3. $10.50. 4. $12. 5. $15.75. 6. $50. 7. $42.67. 8. $120. 9. $105. 10. $264.

Page 47. 1. \$252; \$2652. 2. \$896. 3. \$75. 4. \$26.25. 5. \$56.25. 6. \$63. 7. \$206.25. 8. \$189. 9. \$450. 10. \$782. 11. \$805. 12. \$1077.87. 13. \$7246.25. 14. \$9593.50.

Page 48. 1. 16; 24. 2. 21. 3. 3.1. 4. 7.5. 5. 750. 6. 1875. 7. 4. 8. $\frac{1}{8}$. 9. 1. 10. \$2880. 11. \$289.92.

Page 49. 1. 25%. 2. $33\frac{1}{3}$%. 3. 80%. 4. 50%. 5. $13\frac{1}{3}$%. 6. 20%. 7. 5%. 8. 50%. 9. $23\frac{1}{13}$%. 10. $12\frac{1}{2}$%. 11. $16\frac{2}{3}$%. 12. $12\frac{1}{2}$%. 13. 100%. 14. 100%. 15. 100%. 16. 50%.

Page 50. 1. \$1500; \$500. 2. \$320. 3. \$12,500. 4. 20. 5. 1200. 6. 200. 7. 800. 8. 1000. 9. 90. 10. 70. 11. \$2000. 12. \$5000. 13. \$2250. 14. \$25,000. 15. \$30,000. 16. \$10,000. 17. \$480. 18. \$564. 19. \$2500. 20. \$6500. 21. \$12,500. 22. \$12,480.

Page 51. 1. \$12,000. 2. 5.6%. 3. \$200,000. 4. $5\frac{1}{4}$%. 5. \$1200. 6. \$2000. 7. \$6000. 8. \$7500. 9. \$16,500. 10. \$300. 11. \$7500. 12. 6%. 13. \$5500. 14. $4\frac{1}{2}$%. 15. \$9000. 16. \$446.25. 17. $4\frac{1}{2}$%.

Page 52. 1. \$8400. 2. \$470. 3. \$9400. 4. 30%. 5. 8%. 6. 40%; 14%; 8%.

Page 53. 2. 5. 3. 4. 4. 3. 5. 6. 6. 5. 7. 0.03. 8. $1\frac{1}{2}$.

Page 54. 1. $2\frac{1}{2}$; 5%. 2. 6%. 3. 4%. 4. 5%. 5. 6%.

Page 55. 1. 5 yr. 2. 1 yr. 6 mo. 3. 1 yr. 4. 2 yr. 3 mo. 5. 2 yr. 6 mo.

Page 56. 1. \$4.25. 2. 15%. 3. \$1.38; \$8.56. 4. \$1.67. 5. 4%. 6. 1. 7. \$7000. 8. $7\frac{1}{2}$%. 9. $3\frac{1}{2}$. 10. \$1450.

Page 57. 2. \$10.40. 3. \$13. 4. \$29.25. 5. \$208. 6. \$260. 7. \$546. 8. \$936. 9. \$780. 10. \$1040. 11. \$1950. 12. \$520. 13. \$7280.

Page 59. 1. \$80. 2. \$2.42. 3. \$10.98. 4. \$11,910.16.

Page 60. 1. \$26; \$1. 2. \$0.02; \$26.02. 3. \$52.02; \$26; \$0.52; \$52.54. 4. \$79.58. 5. \$360; \$388.02; \$28.02. 6. \$450; \$467.11; \$17.11. 7. \$1440; \$1600.56; \$160.56. 8. \$1190; \$1263.78; \$73.78. 9. \$9030.56.

Page 61. 1. 20; \$20. 2. 40¢; 10¢. 3. 80¢. 4. \$6. 5. \$10. 6. \$15. 7. \$40. 8. \$1.50. 9. \$3. 10. \$10. 11. \$20. 12. \$50.

Page 62. 1. September, 80; October, 70; November, 90; December, 75; January, 65; February, 85; March, 90; April, 95; May, 85; June, 90. 2. April; January. 3. 82.5; November, February, March, April, May, June; September, October, December, January.

Page 63. 2. 8 A.M., 50°; 9 A.M., 54°; 10 A.M., 60°; 11 A.M., 70°; 12 noon, 80°; 1 P.M., 80°; 2 P.M., 78°; 3 P.M., 82°; 4 P.M., 80°; 5 P.M., 70°; 6 P.M., 60°. 3. 3 P.M.; 8 A.M.

Page 64. 5. 12–15. 8. No; yes. 9. First year, 110; second, 130; third, 140; fourth, 160; fifth, 175; sixth, 180; seventh, 210; eighth, 250; ninth, 270; tenth, 300. 10. 350; 420.

Page 66. 1. \$5.20. 2. $\frac{5}{8}$. 3. \$2.25. 4. $2\frac{1}{2}$ T. 5. 45. 6. 63 lb. 7. 32%. 8. 420. 9. $3\frac{1}{2}$%. 10. \$125.40.

Page 67. 1. 9925. 2. 2500. 3. 9100. 4. 12,100. 5. 2525. 6. 5050. 7. 4400. 8. 10,000. 9. 416,200. 10. 19,100,900. 11. 27. 12. 63. 13. 39.36. 14. 44.44. 15. 16,068.

Page 68. 5. 1512. 6. 23,350. 7. 5200. 8. 3200. 9. 47,750. 10. 96.52. 11. 31,427. 12. 77.456. 13. 35,343. 14. 66. 15. 245,026. 16. 17.067. 17. 11,600. 18. 84,800. 19. 88.92.

Page 69. 1. 3000. 2. 6.72 hr. 3. 400 mi. 4. \$45; \$225. 5. 20. 6. \$462,825. 7. 900. 8. 6. 9. 2700. 10. 2.43. 11. 6000. 12. 54. 13. 243,200. 14. 226.7. 15. \$4100. 16. \$660. 17. 3. 18. 21.

Page 71. 1. 2557. 2. 2356. 3. Correct. 4. Correct. 5. \$13.83. 6. 855. 7. 179. 8. Correct. 9. 6. 10. Correct. 11. Correct. 12. Correct. 13. 310,080. 14. Correct. 15. $807\frac{3}{14}$. 16. $479\frac{2}{15}$.

Page 72. 1. \$32.40. 2. 60 mi. 3. \$10. 4. 140 bu. 5. $9\frac{1}{3}$%. 6. \$10.19. 7. 2:50 P.M.

Page 73. 1. 168 mi. 2. \$3.05. 3. 24 mi. per hour. 4. \$460. 5. 9.

Page 75. 1. \$4200. 2. \$2.66. 4. 40. 6. \$5.04.

Page 76. 1. 22. 2. 78. 3. $1\frac{7}{8}$. 4. $6\frac{15}{16}$. 5. $1\frac{5}{8}$. 6. $15\frac{1}{4}$. 7. $1\frac{1}{2}$. 8. 2. 9. 37. 10. 7. 11. $7\frac{1}{10}$. 12. $\frac{2}{5}$. 13. 10. 14. 3. 15. 7.1. 16. 20. 17. 20.54. 18. 19.38. 19. 3.723. 20. 3.75. 21. 6.44. 22. 84.4. 23. 0.845. 24. 41.04. 25. $10.59\frac{1}{3}$. 26. $9.57\frac{1}{3}$. 27. 10.008. 28. 3.631. 29. 887.28. 30. $2\frac{14}{15}$. 31. 3.51. 32. 48.5. 33. 3.092. 34. 22.61.

Page 78. 1. \$72.50. 2. \$1377.50. 3. \$293.25; \$1661.75. 4. \$205.69. 5. \$18.60; \$136.40. 6. Second; \$14. 7. \$434.25.

Page 79. 1. \$9.70; \$25.70. 2. \$3.56; \$18.06. 3. \$9.44; \$25.94. 4. \$6.26; \$21.26. 5. 12¢; \$17.62. 6. \$2.50; \$18.25.

Page 80. 1. \$51.20; \$588.80. 2. \$78.28; \$588.17. 3. \$609.13. 4. \$14.60; \$151.70. 5. \$53.85; \$298.50. 6. \$67.29; \$496.96. 7. \$142.60; \$804.82.

Page 81. 1. \$297.50; \$8202.50. 2. \$1634.50. 3. \$1062.50. 4. \$9408. 5. \$343.40.

Page 82. 1. 3%. 2. 4%. 3. 3%. 4. 5%. 5. 5%. 6. $3\frac{1}{2}$%. 7. $5\frac{1}{2}$%. 8. \$254. 9. \$1600. 10. \$5000. 11. \$900. 12. \$4000. 13. \$996. 14. \$11,500. 15. \$99. 16. $1\frac{3}{8}$%. 17. \$840. 18. $4\frac{1}{2}$%. 19. \$1005.

Page 83. 1. \$12.14. 2. $2\frac{1}{2}$%. 3. \$817.50; 8%. 4. \$4054.60.

1. \$90.89. 2. 1101.6. 3. 22.832. 4. \$180.97. 5. 94.87. 6. \$8.67. 7. 318.3. 8. \$7613.28. 9. 554.9236. 10. 0.29.

Page 84. 1. 9 lb. 2 oz. 2. $4\frac{3}{4}$. 3. \$21. 4. 87.1 mi. 5. \$466.88. 6. \$68. 7. 32. 8. 15%. 9. \$48. 10. 210.

Page 86. 1. $1464.30. 2. $1736.31. 3. $246.89. 4. $975.65. 5. $977.19.

Page 88. 1. $38.40. 2. $58. 3. $20.80. 4. $45. 5. $45. 6. $49. 7. $54. 8. $120. 9. $250. 10. $560. 11. $150. 12. $1.50. 13. $2.40. 14. $3.30. 15. $16.10. 16. $3; 40%. 17. $2.30; 33⅓%. 18. 40%. 19. 35%. 20. 33⅓%. 21. 24%. 22. 30%. 23. 35%.

Page 89. 1. $12. 2. $150. 3. $20. 4. $15. 5. $25. 6. $36. 7. $90. 8. $64. 9. $110. 10. $104.50. 11. $128.

Page 90. 1. $15.58. 2. $1019. 3. $988.43. 4. $43,210. 5. $896; $851.20; $878.08; $896. 6. $519; $865. 7. 40%.

Page 91. 2. 0.765; $1338.75. 3. $1692; $1692. 4. 0.72; 28%. 5. $306. 6. $612. 7. $1107. 8. $1332. 9. $2428.80. 10. $1128.13. 11. $1262.25. 12. $2070.

Page 92. 1. $19.80. 2. $14.18. 3. $10.11. 4. First. 5. $87.50. 6. $20.20. 7. $127.73. 8. $95.10. 9. $260.08. 10. $306.31. 11. $364.50. 12. $547.62. 13. $634.24. 14. $455.11. 15. $432.40. 16. $521.12. 17. 25%. 18. $1.24. 19. $150. 20. 12½%. 21. $60. 22. 40%. 23. $200. 24. $33.60.

Page 94. 1. 28¢. 2. $1.95. 3. $20. 4. $31.25. 5. $32. 6. $44. 7. $132.50. 8. $220. 9. $5.10. 10. $20.30. 11. $4.50. 12. $51.50. 13. $100. 14. $125.

Page 95. 1. 20¢. 2. $112.50. 3. $10. 4. $16. 5. 50%. 6. $56. 7. $135. 8. $360. 9. 25%. 10. $942.50. 11. 33⅓%. 12. $22.50.

Page 96. 2. 8¢. 3. 6.4¢. 4. $4.75. 5. $1.75; $4.20; $2.63. 6. 28%.

Page 98. 1. 8%. 2. 33⅓%. 3. $2.50. 4. 20¢. 5. 8%; 5.7%. 6. 16⅔%. 7. 10%. 8. $4.50.

Page 99. 1. 8%. 2. 6%. 3. 7.6%. 4. 10%. 5. 30%. 6. 70%; $8. 7. 60%; $50. 8. 38%; $4.50.

Page 100. 1. $1.50. 2. 1st year, $400; 2d year, $575; 3d year, $750; 4th year, $650; 5th year, $1000. 3. 87½%. 4. 13⅓%. 5. 30%. 6. 60%. 7. 60¢; 7½%. 8. 40%. 9. 60%; $15; $20; $35; $42.50.

Page 101. 1. $6; $2. 2. 50%; 40%. 3. 16⅔%. 4. $2. 5. 66⅔%. 6. 25%. 7. 12½%. 8. 6¼%. 9. 16⅔%. 10. 27½%. 11. 40%. 12. 8%.

Page 102. 1. 15%. 2. 5.6%. 3. 15%. 4. 1¼%. 5. 10%. 6. Lose; 50%. 7. 15%; 81¢.

Page 103. 1. $1.50; 15%. 2. 21%. 3. 2. 4. 11.4%.

Page 104. 1. $1.25. 2. 90¢. 3. 34¢. 4. 84¢. 5. 72¢. 6. $1.23. 7. $4.59. 8. 24¢. 9. 95¢. 10. 4¢. 11. 10¢. 12. 8¢. 13. $5.60. 14. 50¢. 15. 39¢. 16. $1. 17. 40¢. 18. $1.25. 19. $3. 20. $1.50. 21. $3.75. 22. $7. 23. 12¢. 24. 15¢. 25. 90¢. 26. $1.35. 27. $1.41. 28. 51¢. 29. 49¢. 30. 3. 31. 24¢. 32. 50¢. 33. 90¢. 34. $28. 35. 97¢. 36. 58¢.

Page 105. 1. $400. 2. $75; $325. 3. $500. 4. $5000. 5. $300; $150 more. 6. 8½%.

Page 106. 4. 2%. 5. 1%. 6. 2½%. 7. 1%. 8. 2%. 9. 4%. 10. 3%. 11. 2%. 12. 2%. 13. ⅛%.

Page 107. 1. ¼. 2. ⅓. 3. ⅙. 4. ⅓. 5. $\frac{1}{12}$. 6. ⅛. 7. ⅔. 8. ⅚. 9. $5. 10. $2.50. 11. $12. 12. $5. 13. $16.50. 14. $150. 15. $162. 16. $240. 17. $465. 18. $750.

Page 108. 1. $3.60. 2. $26.77. 3. 85¢. 4. $17. 5. $18.75. 6. $109.50. 7. $300. 8. $64.25.

Page 109. 1. $62.50. 2. Neither; $30. 3. $408. 4. $43.37. 5. 0.1%. 6. $74.40. 7. $33.70. 8. $5.80. 9. $126.75. 10. $8.75. 11. $98. 12. $50.25. 13. $8. 14. $137.50. 15. $12.60. 16. $38.45. 17. $276.80. 18. $9. 19. $18.75. 20. $14.20. 21. $25.60. 22. $85. 23. $16. 24. $73.25. 25. $683.25.

Page 110. 1. $110.76. 2. 9. 3. $70.40. 4. $555. 5. $319. 6. $4.90. 7. $106.25. 8. 45%. 9. $17.20. 10. $1070.16.

Page 111. 1. $960. 2. $440. 3. $674.50; $285.50. 4. 8; $24.50. 6. $480; $420; $240. 7. $1080. 8. $990. 9. $1800. 10. $573.75. 11. $1375. 12. $2442.

Page 113. 1. $926.50. 2. $929.05. 3. $1381.88. 4. $2945.72. 5. $2515.36. 6. $145.35. 7. $140.37. 8. $381.25. 9. $1927.05. 10. $1889.83. 11. $4727.88.

Page 114. 1. $78. 2. $30. 3. $78; $108. 4. $6; $232 gain. 5. $660; 12; $4290.

Page 115. 11. 16⅔%; 8⅓%. 12. ⅓; 33⅓%. 13. ¼; 25%; 12½%. 14. 50%; 20%; 5%. 25. 31. 26. 12. 27. 30. 28. 10. 29. $60. 30. $200.

Page 116. 1. $3588. 2. 10%. 3. $250; 100%. 4. $90. 5. 25%. 6. 10.5%. 7. $44.25. 8. 304. 9. $542. 10. $16.26.

Page 117. 2. 20%; 30. 3. 75%; 10; 25%. 4. 50; 83⅓%; 16⅔%. 5. 45; 5; 10%. 6. 25; 80%; 5. 7. 48; 100%; 0%.

Page 118. 1. $4697. 2. $10.50. 3. $1.16. 4. $15.81. 5. 28%. 6. $2.10; $3.75; $16.35. 7. 35%; 65%. 8. $10; $15; $55. 9. $525. 10. $3675.

Page 120. 1. 135; 45; 4050; 2; 0.5. 2. 544; 480; 16,384; 16; 0.0625. 3. 650; 600; 15,625; 25; 0.04. 4. 1350; 1296; 35,721; 49; 0.020. 5. 2744; 2548; 259,308; 27; 0.037. 6. 13,320; 12,600; 4,665,600; 36; 0.028. 7. 43,281; 33,663; 185,011,848; 8; 0.125. 8. 1⅜; ⅛; $\frac{15}{32}$; 1⅕; ⅝. 9. $2\frac{7}{8}$; 1⅛; $1\frac{3}{4}$; $2\frac{2}{7}$; $\frac{7}{16}$. 10. 6; 3; $6\frac{3}{4}$; 3; ⅓. 11. $13\frac{1}{3}$; $6\frac{2}{3}$; $33\frac{1}{3}$; 3; ⅕. 12. $1\frac{5}{6}$; ⅝; ⅔; $2\frac{2}{3}$; ⅜. 13. $4\frac{2}{3}$; $2\frac{1}{3}$; $4\frac{1}{12}$; 3; ⅓. 14. $4\frac{1}{2}$; $3\frac{1}{2}$; 2; 8; ⅛. 15. $4\frac{1}{2}$; $1\frac{1}{2}$; $4\frac{1}{2}$; 2; ½. 16. $36\frac{2}{3}$; 30; $111\frac{1}{3}$; 10; $\frac{1}{10}$. 17. 48. 18. 47. 19. 54. 20. 90. 21. $2400. 22. $3. 23. $37.50; $150. 24. $9; $6. 25. 50%; 100%; 200%. 26. 90; 10. 27. 4200; 21,000; 5600; 2800. 28. $1224.

Page 122. 2. $388.75. 3. $399.46. 4. $566.07. 5. $700.91.

Page 124. 13. $212.24. 14. $335.75. 15. $91.37. 20. $250.67. 21. $548.44. 22. $138.08. 23. $1104.37. 24. $1033.21. 25. $778.13. 26. $4896.45; $454.87; $1201.94; $4149.38.

Page 127. 7. $394.44. 9. $6.49. 10. $344.05. 11. $711.39. 12. $923.78. 13. $1034.56.

Page 128. 1. $130. 2. 10 lb. 12 oz. 3. $3\frac{1}{2}\%$. 4. $6.65. 5. $637.50. 6. $211.93. 7. $5\frac{7}{8}$. 8. $31\frac{1}{8}$. 9. $8.40. 10. $93.75. 11. 70. 12. $144\frac{5}{8}$. 13. $204.01. 14. $163.67. 15. $9\frac{1}{4}$. 16. 6. 17. 8. 18. $90. 19. 0.04. 20. 0.03.

Page 129. 2. $1.50; $0.15. 3. $2; $0.20. 4. $3.70; $0.37. 5. $7.40; $0.74. 6. $8.60; $0.86. 7. $9.20; $0.92. 8. $10; $1. 9. $17; $1.70. 10. $18.20; $1.82. 11. $122; $12.20. 12. $145; $14.50. 13. $457.50; $45.75. 14. $2; $6. 15. $4; $12. 16. $7.50; $22.50. 17. $11; $33. 18. $6.25; $18.75. 19. $9.25; $27.75. 20. $75; $225. 21. $125; $375.

Page 130. 1. $3.52. 2. $6; $7. 3. $2.75. 4. $4. 5. $4.32. 6. $6.72. 7. $3.78. 8. $13. 9. $25. 10. $22.50. 11. $43.20. 12. $95.20. 13. $80. 14. $252. 15. $460. 16. $645. 17. $1720.

Page 131. 1. $2. 2. $3. 3. $10.50. 4. $4.80. 5. $11.55. 6. $24.80. 7. $6.30. 8. $3.57. 9. $27.30. 10. $26.46. 11. $30.24. 12. $44.80. 13. $1.30. 14. $3.80. 15. $2.80. 16. $4.68. 17. $46.08. 18. $32.80. 19. $3.60. 20. $2.40. 21. $12.15. 22. $10.23. 23. $46.50. 24. $106.50.

Page 133. 1. $1.17. 2. $6.94. 3. $1.00. 4. $13.33. 5. $1.56. 6. $5.56. 7. 5; $7\frac{1}{2}$; $1\frac{1}{4}$; $2\frac{2}{3}$; 38. 8. *Multiply by:* $\frac{1}{2}$; $\frac{1}{4}$; $\frac{3}{4}$; 0.3; 0.01; 0.02. 9. $13.23. 10. $8.89. 11. $12.50. 12. $42.01. 13. $27.51. 14. $92. 15. $1.56. 16. $1.78. 17. $2.25. 18. $1.50. 19. $6.90. 20. $2.96. 21. $41.25. 22. $15.83. 23. $48.02. 24. $139.40. 25. $19.58. 26. $6.90. 27. $16.64.

Page 134. 1. 184. 2. 190. 3. 181. 4. 66. 5. 226. 6. 68. 7. 240. 8. 113.

Page 135. 1. $18.49. 2. $16.44. 3. $43.20. 4. $55. 5. $108. 6. $205.15. 7. $58; $58.81.

Page 137. 4. 3¢. 6. 42¢. 7. Mar. 31; 25¢. 8. June 30; 75¢. 9. July 15; 50¢. 10. Nov. 4; $1.25. 11. Jan. 5; $3. 12. Sept. 15; $5.

Page 138. 1. $18.75. 2. $15. 3. $8.50. 4. $87.50. 5. $243.75.

Page 139. 1. $16; $3184. 2. $845.75. 3. $1182. 4. $12,487.50. 5. $18,544.20. 6. $5950. 7. $11,880. 8. $24,707. 9. $12,484.50. 10. $650. 11. $1260.

Page 140. 1. $248.75. 2. 30 da. 3. $12; $788. 4. $1250; $1243.75. 5. 6%; $1428.25. 6. 30; $6.40. 7. $3660; 90.

1. $277.80. 2. $1199.25. 3. $1486.66. 4. $601.50. 5. $44.57. 6. $380.65. 7. $5313.75. 8. $4812.80. 9. 16¢. 10. 0.055.

Page 143. 1. $450.90. 2. $18,685.25. 3. $808. 4. $4.04; $803.96. 5. $1412.04. 6. $1654.65. 7. $850.83. 8. $1800.63. 9. $2009.90. 10. $3604.90.

Page 145. 1. 6½. 2. $4.50. 3. $3.60. 4. 21; 21; 1¾. 5. $4.50; 12.9%. 6. 13.3%. 7. 11.4%. 8. 10.7%. 9. 14.8%. 10. 11.1%.

Page 146. 1. $9; $21; $41. 2. 30%. 3. 29.9%. 4. $30; $30.90.

Page 147. 1. $110.38; $121.84; $124.89. 2. $19.41. 3. $8.24; $14.87; $19.51. 4. $2252.40. 5. $496.71; $534.92; $576.05.

Page 148. 1. $253.75. 2. $50.75; $101.50; $507.50. 3. $300; $32.32. 4. $36.63; $4.31. 5. $884; $116. 6. $43,488; $56,512; interest; $13,024. 7. $77,168.40; $22,831.60; amount invested, $54,336.80. 8. $510; $520.20; $530.60. 9. $13.64; $728.62.

Page 150. 1. 3603. 2. 4930. 3. 3431. 4. 3434. 5. $38.60. 6. 3458. 7. 3378. 8. 7975. 9. 6626. 10. $13.43. 11. 2388. 12. 5077. 13. 759. 14. 6257. 15. $41.68. 16. 45,216. 17. 36,632. 18. 71,060. 19. 53,696. 20. 25,662. 21. 27,625. 22. 39,990. 23. 47,922. 24. 48,639. 25. 65,184. 26. 508. 27. 648. 28. 457. 29. 745. 30. 869. 31. 685. 32. 947. 33. 356. 34. 597. 35. 997. 36. 658. 37. 605.

Page 152. 1. Fred, $10; Arthur, $7; Ned, $6; Tom, $3. 2. $64. 3. 750. 4. $4000. 5. 1000; 5000; 25,000. 6. $100.

Page 153. 1. $4. 2. $80. 3. $30. 4. $20. 5. 20¢. 6. $2; $1.40. 7. $14,912.

Page 154. 1. $3. 2. $2.40. 3. $70. 4. $206.25. 5. 7%. 6. 6½%.

Page 155. 1. $150. 2. $2000. 3. $360. 4. $1200. 5. $240.

Page 156. 1. 6500. 2. $8000. 3. $280. 4. $100. 5. $40. 6. 2½%. 7. $4400. 8. $6450. 9. $8125. 10. $2962.50. 11. $12,800. 12. $5980. 13. $17,437.50. 14. $12,250. 15. $90. 16. $99. 17. $169. 18. $140. 19. $462.50. 20. $574. 21. $2112.50. 22. $3533.75.

Page 159. 1. $10.80. 2. $28.80. 3. $50.40; $72; $115.20. 4. $37.50. 5. $2176. 6. $53.13. 7. $7.36. 8. $1050. 9. $568.75. 10. $157.50. 11. $257.60.

Page 161. 1. 26¢. 2. $30; 24¢. 3. $25.50; 30¢. 4. $8200. 5. $96. 6. $2764.80. 7. $9600; $57.60. 8. $5000; $20. 9. 80%; 24¢. 10. $10,000; $9000. 11. $13,500; $94.50.

Page 162. 1. $29.25. 2. $12.40. 3. $16,250. 4. $35. 5. $210.

Page 163. 1. $16.60. 2. $75.50. 3. $6.29. 4. 0.6¢.

Page 165. 1. $599. 2. $54.20. 3. $12.80. 4. $10,194.84. 5. $15,000; $13,729.50. 6. $217.92; $4358.40. 7. $213.57; $6407.10. 8. $214.90; $8596. 9. $519.60; $15,588. 10. $359.40; $7188. 11. $174.75; $873.75. 12. $622.25; $21,778.75.

Page 166. 1. $162.50. 2. $2600; 46.4. 3. $9455.50. 4. $600.50. 5. $87; $1157.10. 6. $1150. 7. $46,000.

Page 167. 1. $131,115.20. 2. 25.3%. 3. 8.4%. 4. $1011.50.

Page 168. 1. $23.10. 2. $5.76. [3. $63. 4. $8386. 5. $192.54. 6. $92. 7. $42. 8. $100.10. 9. $285. 10. $351.60. 11. $446.25. 12. $994.56. 13. $1866.80. 14. $0.22. 15. $0.38. 16. $0.56. 17. $2.56. 18. $1.15. 19. $1.54. 20. $85. 21. $105. 22. $145.

Page 169. 1. $10\frac{1}{2}$; 126. 2. $16\frac{1}{2}$; $5\frac{1}{2}$. 3. 3000; 48,000. 4. 20; 5. 5. 45; 2700. 6. 225; 32,400. 7. 8; 64; 128. 8. 15; 360; 21,600. 9. 7840; 129,360; 43,120. 10. 8 yd. 11. 92 in. 12. 4 ft. 13. $1\frac{7}{8}$ lb. 14. 55 oz. 15. 30 pk. 16. 32 qt. 17. 2600 ft. 18. 9000 lb.

Page 170. 1. Numerator; denominator. 2. 7; 8. 3. Numerator; denominator. 4. 2; 3. 5. Lowest; $2\frac{1}{2}$. 6. Greater; numerator. 7. Number; fraction. 8. Common. 9. Less; numerator. 10. Improper. 11. $\frac{1}{4}$. 12. 12. 13. $\frac{7}{100}$. 14. Mixed; proper; improper. 15. 0.8. 16. $\frac{1}{3}$.

Page 171. 1. *b*. 2. *c*. 3. *d*. 4. *b*. 5. *d*. 6. *a*. 7. *c*. 8. *b*.

Page 172. 1. 0. 2. 0. 3. 1. 4. 1. 5. 1. 6. 0. 7. 1. 8. 2. 9. 1. 10. 0. 11. 1. 12. 0. 13. 1. 14. $\frac{1}{4}$. 15. 0. 16. 1. 17. $\frac{9}{16}$. 18. $1\frac{1}{2}$. 19. $1\frac{5}{8}$. 20. $\frac{1}{8}$. 21. $\frac{1}{2}$. 22. $\frac{1}{8}$. 23. $\frac{5}{16}$. 24. $1\frac{1}{4}$. 25. $\frac{4}{5}$. 26. $1\frac{3}{4}$. 27. $\frac{7}{16}$. 28. $\frac{3}{8}$. 29. $\frac{1}{5}$. 30. 3. 31. $\frac{1}{2}$. 32. $\frac{1}{2}$. 33. $1\frac{1}{8}$. 34. $\frac{8}{9}$. 35. $\frac{3}{5}$. 36. $\frac{15}{16}$. 37. $1\frac{2}{3}$. 38. 2. 39. 3. 40. 4. 41. $66\frac{2}{3}$%. 42. 0.5. 43. 5. 44. 50. 45. 3.006. 46. $\frac{3}{8}$. 47. $\frac{1}{8}$. 48. $62\frac{1}{2}$%. 49. $\frac{1}{3}$. 50. $\frac{7}{8}$. 51. 20%. 52. 25%. 53. 125%. 54. 150%. 55. 2.75; 275%. 56. 3. 57. 50%. 58. $\frac{4}{5}$; 80%. 59. $\frac{3}{4}$; 75%. 60. $\frac{2}{3}$; $66\frac{2}{3}$%.

Page 173. 1. *b*. 2. *c*. 3. *d*. 4. *b*. 5. *c*.

Page 174. 1. *e*. 2. *g*. 3. *k*. 4. *h*. 5. *a*. 6. *l*. 7. *i*. 8. *c*. 9. *f*. 10. *b*. 11. *j*. 12. *d*.

Page 175. 1. *b*. 2. *d*. 3. *a*. 4. *c*. 5. *d*. 6. *b*. 7. *c*. 8. *a*. 9. *d*. 10. *b*. 11. *c*.

Page 176. 1. $134.40. 2. $4440. 3. $504,000. 4. 85%. 5. $207.65. 6. 1.3 in. 7. 780. 8. $25. 9. 780 lb.

Page 177. 1. $336.83. 2. 620,672. 3. 2,082,476. 4. Correct. 5. $298.88. 6. 100.7. 7. 0.45. 8. Correct. 9. $6\frac{1}{4}$. 10. 1. 11. $\frac{1}{2}$. 12. $\frac{4}{21}$. 13. Correct. 14. $600. 15. $642.50.

Page 178. 1. $555.60. 2. 90%. 3. 24,000 lb. 4. 95$\frac{1}{2}$6%. 5. 46.4 mi. 6. 20%. 7. 2437. 8. $3\frac{1}{2}$%. 9. $110. 10. Sleep, $41\frac{2}{3}$%; meals, $8\frac{1}{3}$%; school, $20\frac{5}{8}$%; study and reading, $8\frac{1}{3}$%; play, $12\frac{1}{2}$%; helping mother, $8\frac{1}{3}$%. 11. 60%. 12. $28. 13. $26.75. 15. 11.1%. 16. $7\frac{3}{4}$ lb.; $1\frac{3}{4}$ lb. less; $1\frac{3}{4}$ lb. less; $1\frac{1}{4}$ lb. more; $2\frac{1}{4}$ lb. more. 17. $2.50; $3.75; $13.50. 18. $20. 19. 1.34 lb.

Page 180. 1. 2616. 2. 17,748. 3. $118.31. 4. 15.38. 5. 14.084. 6. 150. 7. 9. 8. $27.77. 9. $7\frac{3}{4}$. 10. 220.9. 11. 274,170. 12. 75,213. 13. 9900. 14. $2821\frac{7}{8}$. 15. 2684. 16. $229.125. 17. 950.6. 18. 268.125. 19. 172.795. 20. 15. 21. $6\frac{3}{4}$. 22. $23\frac{1}{3}$. 23. 53.25. 24. $159.33\frac{1}{3}$. 25. 231.25. 26. 13.09. 27. 0.78. 28. 5250. 29. $32. 30. $41.18. 31. $25.40. 32. $80.35. 33. $5365.10. 34. $562.50. 35. $6.25. 36. $30. 37. $21. 38. $424.80.

Page 185. 1. 4; 4. 2. Equal; 6. 3. 3; equal. 4. 2.

Page 186. 1. 6 in. 2. 6 in.; 10.5 in.; $8\frac{1}{8}$ in. 3. 50%. 4. $66\frac{2}{3}$% less. 5. 2.59. 6. 35.09. 7. 4 (.84); 4 (9.47); 1(1.95). 8. 5 ($1.45); 6 ($24.68); 2 (2.58). 9. 8 (5 lb. 8 oz.); 3 (3 lb. 8 oz.). 10. $6\frac{5}{8}$. 11. $4\frac{3}{16}$. 12. 3. 13. $83\frac{1}{3}$. 14. 4. 15. 0.007. 16. 44.2. 17. 1370. 18. 56. 19. 905. 20. 299.52. 21. 9.821. 22. 0.0048. 23. 59. 24. $18,462.50.

Page 187. 7. Straight line *AB*. 8. Right angle. 9. Straight line *AB*. 10. Obtuse angle. 11. Acute angle.

Page 190. 1. (3), (4), (5), (6), (8). 2. (1), (2), (7). 3. (1), (2), (4), (6), (7). 4. (8). 5. (1), (2), (3), (5), (6), (7). 6. (2), (6). 7. (2), (7). 8. (2), (6), (7). 9. (2), (7). 10. (8). 11. 90°; 4; 360°. 13. Right angles.

Page 191. 1. *DC*; *DC*; *BC*. 2. Right; perpendicular. 3. Parallel; equal; *WX*; *h*.

Page 192. 1. $12\frac{1}{2}$ sq. in.; 21 sq. in. 2. 102 sq. in. 3. 116 sq. in. 4. 120 sq. in. 5. $10\frac{1}{8}$ sq. in. 6. 11 sq. ft. 7. 54 sq. ft. 8. 6400 sq. rd. 9. $146\frac{2}{3}$ sq. ft.

Page 193. 1. Rectangle. 2. 98 sq. in. 3. 144 sq. in. 4. 93 sq. ft. 5. $195\frac{1}{2}$ sq. yd. 6. $37\frac{1}{8}$ sq. rd. 7. 150 sq. in. 8. 225 sq. mi. 9. $156\frac{1}{4}$ sq. yd. 10. $112\frac{1}{2}$ sq. ft. 11. $214\frac{1}{16}$ sq. in.

Page 194. 1. 882 sq. ft. 2. 285 sq. in. 3. 4000 sq. yd. 4. 62,500 sq. ft.; 131,750 sq. ft.; 236,740 sq. ft.; 430,990 sq. ft. 5. 64.3%. 6. Same. 7. Yes. 8. 5625; 45 ft.

Page 195. 1. 6; square. 2. 8 sq. in.; 8 sq. in.; 4 sq. in.; 4 sq. in.; 2 sq. in. 3. 28 sq. in. 4. 6 sq. in. 5. 24 sq. in. 6. 4; multiplies it by 4.

Page 196. 1. 72 cu. in. 2. 30 cu. ft. 3. 8 cu. in.; 64 cu. in. 4. $61\frac{3}{4}$ cu. ft. 5. 224. 6. 2.0 cu. ft. 7. $9\frac{3}{8}$. 8. 71.6 lb. 9. 1000. 10. 510; 31,875 lb. (15.9 T.). 11. 1020. 12. 15,644.4. 13. $\frac{1}{8}$.

Page 199. 1. (2), (4), (6), (8). 2. (1), (3), (5), (7). 3. (2), (8). 4. Cube. 5. Pentagonal; triangular; square. 6. Square; triangular; hexagonal. 7. 6; 7; 5. 8. 4; 7; 5. 9. 10; 6; 8. 10. 7; 4; 5. 11. 6; 15; 12.

Page 200. 1. 80¢. 2. 47. 3. 384. 4. $1023\frac{3}{4}$. 5. 25 sq. in. 6. 13 sq. in. 7. $29\frac{1}{4}$ sq. in. 8. $42\frac{7}{8}$ cu. in. 9. $87\frac{3}{4}$ cu. ft. 10. $7\frac{7}{8}$. 11. $56\frac{1}{3}$. 12. $37\frac{5}{8}$. 13. 18.7. 14. $60\frac{1}{8}$. 15. 0.57. 16. 49.5. 17. 26.25. 18. 81. 19. $305\frac{1}{4}$. 20. 12,320. 21. $1968\frac{3}{4}$.

Page 202. 1. A; B. 2. A; B. 3. AD, BC; AD, BC; AB, DC; AB, DC; AD, BC. 4. From A to BC; from B to AC; from A to BC; from B to AC. 5. AB or DC; AD or BC; AD or BC; AB or DC.

Page 203. 1. Semicircle. 2. Semicircle. 3. Hemisphere. 4. Semicircle; half of a cylinder. 6. 7 in.; 5 ft. 2 in.; $9\frac{3}{4}$ in.; 5 in. 7. $1\frac{3}{4}$ in.; 2 ft. $1\frac{1}{2}$ in.; $2\frac{7}{8}$ in. 8. Right angle. 9. Vertical line. 10. Vertical line. 11. Obtuse angle. 12. Acute angle.

Page 204. 1. 10. 2. 24. 3. 40%. 4. 96. 5. \$420. 6. 1.44 T. 7. $18\frac{3}{4}$%. 8. \$24.75. 9. 25%. 10. \$2.64.

Page 205. 1. Horizontal. 2. Three; parallel. 3. Oblique. 4. Three. 5. Parallel. 6. Four. 7. Equal.

Page 207. 1. Isosceles. 2. Hemisphere.

Page 210. 1. $232\frac{8}{11}$. 2. Length and width; length of one side; length of an edge; length, width, and height. 3. \$192. 4. \$32. 5. $27\frac{5}{8}$ sq. in. 6. $18\frac{1}{3}$ sq. ft. 7. 375 sq. yd. 8. $28\frac{7}{16}$ sq. yd. 9. 3492. 10. 2428. 11. 15.56. 12. 152.6. 13. 50.47. 14. 61.05. 15. 1.166. 16. 23.5. 17. 19,872. 18. 1013.54. 19. 188.68. 20. 0.9828.

Page 212. 18. $3\frac{3}{4}''$; 5.4''; 10.4'; 7'. 19. $4\frac{1}{2}''$; $3\frac{3}{4}'$; $1\frac{5}{8}''$; 2' 3''; 2' $10\frac{1}{2}''$.

Page 214. 3. 130°; 90°; 95°. 4. 90°. 5. 90.

Page 215. 1. 180°; 180°; 360°; 360°. 3. 90°. 5. 4.

Page 216. 1. 68° 28'. 2. 39° 53'. 3. 54° 59'. 4. 33° 0'. 5. 61° 27'. 6. 47° 32'. 7. 30° 0'. 8. 17° 1'. 9. 196° 4'. 10. 99° 32'. 11. 180°; 540°. 12. 108°.

Page 221. 1. 37,017. 2. 28,450. 3. 22,131. 4. 11,806. 5. 1631.8. 6. 7224. 7. 23. 8. 1.304. 9. 163.4. 10. 30.74. 11. \$5080.80; 121,440 ft. 12. \$4.76; \$860. 13. $11\frac{1}{8}$. 14. $5\frac{3}{4}$. 15. 4.15. 16. 5.164. 17. $2\frac{1}{8}$. 18. $1\frac{7}{8}$. 19. $2\frac{1}{8}$. 20. $2\frac{4}{5}$. 21. $6\frac{5}{12}$. 22. $\frac{9}{20}$. 23. $4\frac{1}{8}$. 24. 1.61. 25. 20.88. 26. 0.81. 27. 16.1. 28. 0.3096. 29. $2\frac{9}{16}$. 30. $\frac{9}{14}$. 31. 3. 32. 30. 33. 2. 34. 200.

Page 229. 1. 57°; 57°; 57°. 2. a, a'; b, b'. 3. $37\frac{1}{2}$°. 4. $142\frac{1}{2}$°. 5. 360°. 6. 360.

Page 230. 1. 45°. 2. 135°. 3. 80°; 30°; 1°. 4. 115°; 50°; 179°. 5. 40°; 40°. 6. 140°. 7. 140°. 8. 140°. 9. 40°. 10. 40°. 11. 140°.

Page 231. 1. 90°; 90°. 2. $\frac{1}{2}$. 3. $\frac{1}{8}$. 4. $\frac{1}{24}$. 5. $\frac{1}{12}$. 6. $\frac{3}{8}$. 7. 50°. 8. 180°; 130°; 130°. 9. 135°. 10. 40°. 11. 95°. 12. 50°. 13. 25°. 14. 130°. 15. 110°. 16. 25°. 17. 70°.

Page 232. 2. North. 3. West. 4. Southwest. 5. South. 6. Southwest; south. 7. Southeast.

Page 233. 1. 60. 2. 1.1%; 1.5%; 1.1%.

Page 234. 1. 132,000. 2. Sierra Nevada; 11,500 ft. 3. 140. 4. 82. 5. 560 ft.; 830 ft. 6. 5570. 7. 1700 ft.; 85.2%. 8. 15 hr. $57\frac{1}{2}$ min.

9. 22.5%. 10. 5 hr. 48 min. 11. 1.6. 12. 120 mi. 13. 157.32. 14. 14.9¢. 15. 84.5 mi.

Page 236. 1. *b*. 2. *d*. 3. *c*. 4. *b*. 5. *b*. 6. *d*. 7. *c*. 8. *c*. 9. *a*. 10. *a*. 11. *c*. 12. *b*.

Page 237. 1. 3282. 2. 27,286. 3. $142.49. 4. 19.98. 5. 22.956. 6. 149. 7. 5567. 8. $12.27. 9. 1.89. 10. 189.1. 11. 17,334. 12. 84,710. 13. $6136\frac{2}{3}$. 14. $31.50. 15. 13.76. 16. 13.965. 17. 51.2. 18. 154. 19. $20\frac{2}{5}$. 20. $356. 21. 162. 22. 28.5. 23. $34. 24. $309. 25. $392.70. 26. 465 ft. 27. 7.128 lb. 28. 242.31 cu. in. 29. $0.75. 30. 20%. 31. 317.5. 32. 125. 33. $9\frac{3}{8}$. 34. $33\frac{1}{3}$%.

Page 238. 1. 40¢. 2. Impossible. 3. $1.35. 4. Impossible. 5. Impossible. 6. $\frac{7}{10}$. 7. 77¢. 8. Impossible. 9. 28¢.

Page 240. 1. 400. 2. $1.60. 3. $41\frac{2}{3}$%. 4. $6.83\frac{1}{3}$. 5. 13.6; 7.2 hr. 6. $60.

Page 241. 1. 0.3 bu. 2. 48¢. 3. $66\frac{2}{3}$%. 4. $91.20. 5. $18\frac{1}{3}$%. 6. 40. 7. $41\frac{1}{4}$ in. 8. 100%. 9. $6000. 10. 80%.

Page 242. 1. *a*. 2. *b*. 3. *d*. 4. *c*. 5. *b*. 6. *c*. 7. *c*. 8. *d*. 9. *a*. 10. *d*.

Page 243. 1. 2212. 2. 3103. 3. 3736. 4. $38.03. 5. $33.30. 6. 3583. 7. 978. 8. 2879. 9. 3966. 10. $24.79. 11. 1469. 12. 5678. 13. 557. 14. 5519. 15. $48.86. 16. 20,223. 17. 46,350. 18. 51,456. 19. 9065. 20. $851.62. 21. 32,430. 22. 67,106. 23. 39,379. 24. 19,803. 25. $577.92. 26. 274. 27. 305. 28. 568. 29. 187. 30. 689. 31. 538. 32. 243. 33. 416. 34. 296. 35. 698. 36. 187. 37. 412. 38. 264. 39. 907. 40. 503.

Page 246. 1. $26.25. 2. $138.64. 3. $74.25. 4. 200. 5. 495. 6. $22.50.

Page 247. 1. $23.25. 2. $172.73. 3. 29.216. 4. 263.84. 5. 119.826. 6. $1.38. 7. $28.08. 8. 1.149. 9. 6.742. 10. 0.5225. 11. $1.01. 12. $2.19. 13. 1.963. 14. 29.05. 15. 989.6. 16. $3365.18. 17. 618.26 ft. 18. 2.2662. 19. 58.368. 20. $57,537.20. 21. 9296.4 mi. 22. 6087.235. 23. 128.0037. 24. $1.27. 25. $2.07. 26. $3.12. 27. $3.85. 28. 1.52. 29. 2.46. 30. 15.7. 31. 0.297. 32. 3.09. 33. 13.51. 34. 12.47. 35. 62.84.

Page 248. 1. $1.50. 2. 70¢. 3. 90¢. 4. 4¢. 5. 60%. 6. $3.42. 7. $1.72.

Page 249. 1. $\frac{5}{8}$. 2. $\frac{7}{8}$. 3. $\frac{5}{16}$. 4. $\frac{13}{16}$. 5. $2\frac{1}{4}$. 6. $7\frac{9}{16}$. 7. $1\frac{1}{2}$. 8. $1\frac{5}{8}$. 9. $\frac{15}{16}$. 10. $\frac{3}{5}$. 11. $6\frac{1}{4}$. 12. $12\frac{7}{8}$. 13. $\frac{1}{16}$. 14. $\frac{7}{16}$. 15. $\frac{1}{5}$. 16. $\frac{9}{16}$. 17. $1\frac{9}{16}$. 18. $1\frac{5}{8}$. 19. $\frac{3}{16}$. 20. $\frac{3}{10}$. 21. $\frac{3}{16}$. 22. $\frac{3}{16}$. 23. $3\frac{3}{4}$. 24. $2\frac{13}{16}$. 25. $\frac{3}{8}$. 26. $\frac{1}{3}$. 27. $\frac{1}{5}$. 28. $\frac{9}{32}$. 29. $\frac{5}{16}$. 30. $\frac{1}{4}$. 31. $4\frac{19}{32}$. 32. $18\frac{3}{8}$. 33. $7\frac{7}{8}$. 34. $\frac{1}{3}$; 3. 35. $\frac{3}{4}$; $\frac{1}{4}$; $\frac{1}{8}$; 2; $\frac{1}{2}$. 36. $\frac{5}{8}$; $\frac{1}{8}$; $\frac{3}{32}$; $1\frac{1}{2}$; $\frac{2}{3}$. 37. $1\frac{1}{8}$; $\frac{1}{8}$; $\frac{5}{16}$; $1\frac{1}{4}$; $\frac{4}{5}$. 38. $1\frac{5}{8}$; $\frac{1}{8}$; $\frac{21}{32}$; $1\frac{1}{6}$; $\frac{6}{7}$. 39. $\frac{5}{6}$; $\frac{1}{6}$; $\frac{1}{8}$; $1\frac{1}{2}$; $\frac{2}{3}$. 40. $1\frac{3}{8}$; $\frac{3}{8}$; $\frac{7}{16}$; $1\frac{3}{4}$; $\frac{4}{7}$. 41. $\frac{7}{8}$; $\frac{5}{8}$; $\frac{3}{32}$; 6; $\frac{1}{8}$. 42. $\frac{7}{8}$; $\frac{3}{8}$; $\frac{5}{32}$; $2\frac{1}{2}$; $\frac{2}{5}$. 43. $\frac{5}{8}$; $\frac{3}{8}$; $\frac{1}{16}$; 4; $\frac{1}{4}$. 44. $1\frac{1}{4}$; $\frac{1}{4}$; $\frac{3}{8}$; $1\frac{1}{2}$; $\frac{2}{5}$. 45. $1\frac{1}{4}$; $\frac{5}{8}$; $\frac{7}{32}$; $3\frac{1}{2}$; $\frac{2}{7}$. 46. $1\frac{1}{8}$; $\frac{3}{8}$; $\frac{9}{32}$; 2; $\frac{1}{2}$. 47. $9\frac{1}{4}$; $1\frac{3}{4}$; $20\frac{5}{8}$; $1\frac{7}{15}$; $\frac{15}{22}$. 48. $9\frac{3}{4}$; $2\frac{3}{4}$; $21\frac{7}{8}$; $1\frac{11}{14}$; $\frac{14}{25}$. 49. $4\frac{1}{16}$; $\frac{5}{16}$; $4\frac{13}{128}$; $1\frac{1}{6}$; $\frac{6}{7}$. 50. $5\frac{1}{8}$; $1\frac{5}{8}$; $5\frac{29}{32}$; $1\frac{13}{14}$; $\frac{14}{27}$.

Page 250. 1. 6. 2. 11,000,000. 3. 9.2%. 4. 74%. 5. 1.5 lb. 6. 6.45. 7. 5.5%. 8. 1240 lb. 9. Butter fat, 412; water, 69.5; salt, 12.5; curd, 6. 10. 837 lb.; 234.36. 11. Bessie; 0.4 lb. 12. 96.6; 82.5. 13. 1771 lb. 14. $885.50.

Page 252. 1. $30; $0.60. 2. $\frac{6}{100}$; $200; $12. 3. $80; $20. 4. $\frac{1}{2}$; $50; $25. 5. $5; $5. 6. $8; $10. 7. $\frac{4}{100}$; $\frac{1}{25}$. 8. $\frac{5}{100}$; $\frac{1}{20}$. 9. $\frac{50}{100}$; $\frac{1}{2}$. 10. $\frac{10}{100}$; $\frac{1}{10}$. 11. $\frac{20}{100}$; $\frac{1}{5}$. 12. $\frac{75}{100}$; $\frac{3}{4}$. 13. $\frac{100}{100}$. 14. $\frac{12\frac{1}{2}}{100}$; $\frac{25}{200}$; $\frac{1}{8}$. 15. $\frac{37\frac{1}{2}}{100}$; $\frac{75}{200}$; $\frac{3}{8}$. 16. $\frac{33\frac{1}{3}}{100}$; $\frac{100}{300}$; $\frac{1}{3}$. 17. $10.50. 18. $13.75. 19. $22.50. 20. $63.75. 21. $16.25. 22. $13.80. 23. $66.15. 24. $36.64. 25. 10. 26. 10. 27. 550. 28. $26.25. 29. $46. 30. 0.

Page 253. 1. 37,519,300,000 lb. 2. 3,650,000. 3. 462,500 T. 4. 337,500 T. 5. 4,218,750 T. 6. 8,925,000.

Page 254. 1. 829. 2. 50,875 lb. 3. 19,300 lb.; $1302.75. 4. 9.2¢. 5. 15.5¢. 6. $207.70. 7. 6000. 8. 4734. 9. 2,403,000; 182.5%. 10. $120,000.

Page 255. 1. $8\frac{3}{8}$. 2. $1\frac{3}{8}$. 3. $17\frac{1}{16}$. 4. $1\frac{11}{28}$. 5. 1. 6. 0. 7. 2.25; $2\frac{1}{4}$. 8. 100; 200. 9. 75%; 25%; 100%. 10. 1%; 0.1%; 10%; 75%; 75%.

Page 256. 1. Second graph. 2. 21%. 3. 15%. 4. 18%. 5. Second graph. 6. 12% increase. 7. No change. 8. 2% decrease. 11. First graph.

Page 258. 1. $60.86. 2. $19.97. 3. 76.52. 4. 62.88. 5. 497.5. 6. $9.69. 7. $8.39. 8. 6.48. 9. 64.33. 10. 3.845. 11. $63.45. 12. $23.37. 13. 3.216. 14. 813.218. 15. 1.8054. 16. $67.15. 17. $43.89. 18. 130.645. 19. 396.753. 20. 1636.8. 22. 1.08. 23. 108. 24. 0.108. 25. $27. 26. 45¢. 27. $4.50. 28. 4.5. 29. 450. 30. 2.7. 31. 0.027. 32. 2.7. 33. 0.81.

Page 259. 1. $1,753,498,100; $1,175,024,500. 2. $4503. 3. 1140. 4. Bread flour, 42,000; coarse flour, 600; Red Dog flour, 1200; shorts or bran, 16,200.

Page 260. 1. $8.98. 2. 12.9%. 3. 167. 4. 59.9%. 5. 35.9%. 6. 0.6%. 7. 0.9%. 8. 1.2%. 9. 275°. 10. $3; 3¢. 11. $4166\frac{2}{3}$. 12. $3502. 13. 420,000. 14. 41 lb. 4 oz. 15. 52 lb. 8 oz.; 35 lb. 16. 200 lb. 17. 90 lb. 18. 9-cent loaf; 0.03¢. 19. 0.07¢ cheaper per ounce than 9-cent loaf; 0.04¢ cheaper per ounce than 10-cent loaf.

Page 262. 1. $1.44. 2. 40%. 3. 1470. 4. 2580. 5. 2058; 3612. 6. 12%. 7. 88%. 8. 66. 9. 12; 48; 12. 10. 36. 11. 1728 bu. 12. 864 bu. 13. 1536 bu. 14. 1632 bu. 15. 672 bu. 16. Nitrogen, 80; phosphoric acid, 160; potash, 80. 17. $51.

Page 264. 1. 14,014,000; 28,028,000,000. 2. 69,300. 3. 77,962$\frac{1}{2}$. 4. 347. 5. 876; 10,862.4. 6. 11$\frac{1}{9}$%. 7. 0.6%. 8. 14.7%.

Page 266. 1. 1 yd. 9 in. 2. 48. 3. $\frac{1}{2}$ in. 4. $58\frac{1}{3}\%$. 5. $66\frac{2}{3}\%$. 6. 24. 7. 3630. 8. \$181.25. 9. $312\frac{1}{2}$ lb. 10. 400.

Page 267. 1. 16,945,425. 2. 0.02%. 3. 36.9%. 4. 1,201,725,000,000; 10,014. 5. Industries, 35%; railroads, 25%; heating and cooking, 16.5%; coke, 13%; exported, 6%; coal-mine fuel, 3.5%; gas works, 1%. 6. 5.4%.

Page 268. 1. 71.4%. 2. $\frac{3}{4}\%$. 3. $7\frac{1}{2}$ T. 4. \$7.50. 5. 40%. 6. 3600. 7. 2.5. 8. 25.7%. 9. 2,100,000 cu. ft. 10. 288,000 gal.

Page 270. 1. 36 long tons; 63 long tons; 75%. 2. 96. 3. 5712. 4. 550.

Page 271. 1. *e.* 2. *j.* 3. *a.* 4. *b.* 5. *c.* 6. *i.* 7. *d.* 8. *f.* 9. *g.* 10. *h.* 11. *o.* 12. *s.* 13. *k.* 14. *l.* 15. *r.* 16. *m.* 17. *n.* 18. *t.* 19. *p.* 20. *q.* 21. *d.* 22. *e.* 23. *c.* 24. *a.* 25. *b.*

Page 272. 1. 4 H.P. 2. 2.8%. 3. 1,980,000 H.P. 4. 31.5%.

Page 273. 1. \$8. 2. \$28. 3. \$17.50. 4. \$50. 5. \$240. 6. 3.2 mi. 7. 2.7 ft. 8. 7.2 yd. 9. 720 H.P.

Page 274. 1. Percentage by the base. 2. 25%. 3. 50%. 4. 200%. 5. 100%. 6. 100%. 7. 20%. 8. 25%. 9. 40%. 10. 400%. 11. $16\frac{2}{3}\%$. 12. 600%. 13. 60%. 14. 42.9%.

Page 275. 1. 200,000 H.P. 2. \$500. 3. \$200. 4. \$4000. 5. \$20,000. 6. \$40,000. 7. 80 mi. 8. 14 ft. 9. 592 H.P. 10. 1800 H.P. 11. 640 H.P.

Page 276. 1. $\frac{1}{2}$. 2. $\frac{1}{2}$. 3. $\frac{1}{4}$. 4. $\frac{1}{4}$. 5. $\frac{1}{3}$. 6. $\frac{1}{12}$. 7. $\frac{25}{26}$; $\frac{26}{25}$. 8. $\frac{1}{120}$. 9. $\frac{1}{4}$; 25%. 10. $\frac{25}{28}$; $\frac{28}{25}$. 11. $\frac{1}{4}$; $\frac{4}{1}$. 12. $\frac{3}{5}$. 13. $\frac{1}{10}$. 14. $\frac{2}{27}$. 15. $\frac{1}{2}$; $\frac{5}{6}$; $\frac{1}{1}$; $\frac{5}{12}$; $\frac{5}{2}$. 16. $1\frac{1}{2}$; 3; $\frac{1}{2}$. 17. 3; 3; 3; $5\frac{2}{3}$.

Page 278. 1. 180°. 2. 1660. 3. 203°. 4. 20,000.

Page 279. 2. 300 lb. 3. 440 lb.; 700 lb. 4. 129.4%.

Page 280. 1. 149.25. 2. Water power, 25,875,000; steam, 49,125,000. 3. 29,104,478. 4. 1.55.

Page 281. 1. 22¢. 2. \$1.51. 3. 45¢. 4. 34¢. 5. 20¢. 6. 94.5; \$9.45. 7. 25; 0.2¢.

Page 282. 1. 33,600,000,000. 2. 8.9%. 3. Fuel oil, 47.9%; gasoline, 25.7%; kerosene, 9.8%; paraffin and mineral oil, 6.0%; wax, coke, and asphalt, 2.4%; lubricating oil, 4.3%. 4. \$2,100,000,000. 5. 13.9 gal. 6. 28,000.

Page 283. 1. 7,000,000,000; \$700,000,000. 2. 166.7 lb. 3. 500. 4. 12,600,000 bales.

Page 284. 1. Australia, $\frac{1}{4}$; United States, $\frac{1}{10}$; 40%. 2. 38,961,039. 3. 42.9%. 4. 4.7. 5. 1136.4. 6. 320,000. 7. \$4.66. 8. 17,777,778 lb.

Page 285. 1. 3.7%. 2. \$597. 3. 18.2%. 4. 15.4%. 5. 54.2%. 6. 52,002,000. 7. \$25. 8. \$20. 9. 26.1%.

Page 286. 1. $68. 2. 22.2%; $32. 3. $2.50. 4. $4.50. 5. $3.75. 6. $2.25. 7. $13. 8. $13.

Page 287. 1. $72. 2. $28, more. 3. $11.50. 4. 75¢. 5. $2.50, more. 6. $20. 7. $4.40. 8. $2.65, less.

Page 288. 1. 1077. 2. 721.7. 3. 10,557 mi. 4. $132\frac{1}{8}$. 5. $133\frac{1}{8}$. 6. 404. 7. $15.16. 8. 3244 ft. 9. $28\frac{1}{8}$. 10. $48\frac{9}{16}$. 11. 15,984. 12. 850. 13. 18,981. 14. 5600 ft. 15. $4387.50. 16. 88 sq. in. 17. $1.50. 18. $1.56. 19. 65. 20. $119.20. 21. 270. 22. 19.5. 27. 181. 28. $\frac{1}{2}$. 29. 20%. 30. 25%. 31. 50%. 32. $105. 33. $66\frac{2}{3}$%. 34. $133\frac{1}{3}$%. 35. 50%. 36. 25%.

Page 289. 1. 5 hr. 2. 4 hr. 27 min. 3. 4 hr. 42 min. 4. 3 hr. 38 min. 5. 3 hr. 5 min. 6. 24 min. 7. 1 hr. 40 min. 8. 15 min. 9. 27 min. 10. 9 min. 11. 5 min.

Page 290. 1. 10. 2. 2 hr. 20 min.; 9 hr. 20 min. 3. 46 hr. 40 min. 4. 700. 5. 8.6. 6. 700 da. 7. 20 da.; 4 hr. 10 min.; 2 hr. 8. 819.95. 9. 6.8%. 10. 110. 11. 800. 12. $4.50; $4\frac{1}{2}$¢. 13. 40; $200; $10. 14. 288. 15. 16,250. 16. 5.2%. 17. 56.4%.

Page 292. 1. 5. 2. 77.1%. 3. 1683.9%. 4. 3.2%. 5. 56.6%.

Page 293. 1. $112. 2. $25.50; $4.50. 3. 8046 mi. 4. 15¢; 40%. 5. $34. 6. 9728. 7. $203.57. 8. $24.

Page 294. 1. 54,438. 2. 36.2%. 3. 13.3%. 4. 10.3%. 5. 13.7%. 6. 2.2%. 7. 7.9%.

Page 295. 1. 66,004. 2. 28.4%. 3. 30.6%. 4. 6.2%. 5. 22.3%. 6. 2.2%. 7. 10.6%.

Page 296. 1. 1083. 2. 76.1 mi. 3. 90.3 mi. per hour. 4. $148.40.

Page 297. 1. 73.2%. 3. 27.0. 4. 2,000,000. 5. $\frac{3}{20}$.

Page 298. 1. 85¢. 2. $19.28. 3. $4.83; $2.25. 4. 379.2%. 5. $239.95. 6. $221.94; $220.67; $235.12; $237.70; $191.95.

Page 299. 1. 170,240,000 A. 2. $\frac{1}{6}$. 3. $\frac{2}{5}$. 4. $\frac{14}{15}$. 5. $\frac{4}{15}$. 6. $\frac{4}{5}$.

Page 300. 2. 256. 3. 360. 4. 72. 5. 224. 6. 336. 7. 200. 8. 128. 9. 672.

Page 301. 1. 240 sq. ft. 3. $138.07. 4. 53.8%. 5. $14. 6. $22.50. 7. $6.25.

Page 302. 1. Architect's fee, $750; labor, $3000; materials, $3750. 2. Lumber, $1372.50; brick, etc., $524.60; plumbing, $314.15; heating equipment, $256.20; electric equipment, $169.80; roofing, $170.80; paint, $122; hardware, $76.25; miscellaneous, $103.70. 3. $\frac{7}{8}$; $\frac{41}{45}$. 4. $\frac{5}{8}$. 5. $\frac{2}{5}$. 6. $22.75. 7. 160.

Page 303. 1. 534 ft. 2. 28,000 sq. ft. 3. $4,261,320. 4. 16%; 0.7%. 5. $6875.

Page 304. 1. 2,300,400 sq. mi. 2. 858⅓ T. 3. 64,100%. 4. 16,055,156. 5. 422,400 lb. 6. 37,714 long tons. 7. 128.0%; 69.5%. 8. 9.5%; 13.0%.

Page 305. 1. Frank's; $940,000,000. 2. $39,312,000. 3. $227,200,000. 4. Frank's; $950,688,000. 5. 1064.1 lb. 6. 6.4¢. 7. 76,000.

Page 306. 1. 84%; 16%. 2. Zinc, 10.7 lb.; tin, 112.8 lb.; copper, 338.4 lb. 3. 24.4%; 2.3%; 73.3%. 4. 90%. 5. 75%. 6. 72.5 lb. 7. 940.5 lb. 8. $\frac{9}{41}$; $\frac{9}{50}$; $\frac{41}{50}$. 9. 410.

Page 307. 1. 464. 2. 164. 3. 7400. 4. 375. 5. 70. 6. 5. 7. 1. 8. 3. 9. $7.20. 10. $2.50. 11. $5.25. 12. $17. 13. 62 in. 14. 11 ft. 15. 10.99 ft. 16. 3960 ft. 17. 4 gal. 18. 320 yd. 19. 6¼. 20. 15. 21. 1¼. 22. 5. 23. 2. 24. 3. 25. ¾. 26. 3¾. 27. 13⅓. 28. 66. 29. 5½. 30. 8⅞. 31. 3. 32. 4⅓. 33. 1⅓. 34. 4.2. 35. 4.2. 36. 0.42. 37. 0.2. 38. $\frac{1}{32}$. 39. 10%. 40. 12,500%. 41. 7½%. 42. 5%. 43. 528.

Page 308. 1. 59⅜ yd. 2. 25¢. 3. 80%. 4. 82⅔. 5. 56¼ gal. 6. 75¢. 7. $33.75. 8. 18. 9. $9\frac{9}{64}$. 10. 18¾%. 11. $1\frac{2}{17}$. 12. ½. 13. 3. 14. 425. 15. 33⅓%. 16. 50%. 17. 48.6. 18. $18. 19. $24. 20. $30. 21. $67.50.

Page 310. 1. 1880, 9,000,000; 1890, 12,500,000; 1900, 16,000,000; 1910, 17,500,000; 1920, 22,000,000; 1930, 24,000,000. 2. 15. 3. 1880, 280,000; 1890, 360,000; 1900, 420,000; 1910, 520,000; 1920, 670,000; 1930, 940,000. 4. 6.6. 5. $400,000,000; $1,000,000,000; $2,200,000,000. 6. $22.86; $45.45; $91.67.

Page 311. 1. 1953.6; 1001.16. 2. 195.36. 3. 19.536. 4. 100.116. 5. 0.19536. 6. 100.116. 7. 19.536. 8. 10.0116. 9. 1.9536. 10. 0.100116. 11. 195.36. 12. 1197. 13. 1652.91. 14. 37.856. 15. 915.936. 16. 2473.12. 17. 7.8592. 18. 437.669. 19. 214,247.8. 20. 15,974.4. 21. 39,187.92. 22. 845.34. 23. 608.35. 24. 1258.037. 25. 0.9375. 26. 13.3272. 27. 428.12. 28. 88,735.72. 29. 210.0117. 30. 3627.36. 31. 420.8004. 32. $1.34. 33. $1.20. 34. $0.96. 35. $0.72. 36. $1.48. 37. $1.42. 38. $4.56. 39. $3.29. 40. 128.62. 41. 82.55. 42. 16.54. 43. 98.2.

Page 312. 1. 3. 2. 945,000. 3. 18.72. 4. 0.00025%. 5. $416,000. 6. 14%. 7. $10,080.

Page 314. 1. 83⅓ hr. 2. 7; 700,000. 3. 60.5. 4. 108,333⅓. 5. 72,222.2.

Page 315. 1. 26 lb. 12 oz. 2. 41 ft. 4 in. 3. 13 yd. 14 in. 4. 1 hr. 35 min. 5. 1 da. 6 hr. 6. 3 mo. 25 da. 7. 4 yr. 4 mo. 26 da. 8. 5 yr. 6 mo. 6 da. 9. 6 yr. 7 mo. 23 da. 10. 7 ft. 2 in. 11. 31 lb. 15 oz. 12. 31 yd. 13. 1 ft. 3 in. 14. 1 yd. 5 in. 15. 1 yd. 23 in. 16. 4 lb. 15 oz. 17. 3 lb. 5 oz. 18. 8 bu. 3 pk. 19. 1 hr. 17 min. 20. 1 hr. 36 min. 21. 1 hr. 31 min. 22. 3 in. 23. 34 ft. 24. 3.4 in. 25. 6 ft. 6 in. 26. 1 yd. 27 in. 27. 7 ft. 28. 7.05 ft. 29. 2 hr. 20 min.

Page 316. 2. 1200. 3. 16 min. 40 sec. 4. 6 min. 40 sec. 5. 88.5.

Page 317. 1. \$5.50. 2. $\frac{5}{24}¢$. 3. 14.3%. 4. \$1.11. 5. $12\frac{1}{2}¢$. 6. $1\frac{1}{20}$. 7. 16. 8. 1.1¢.

Page 319. 1. $\frac{p}{6}=\frac{20}{30}$; 4 in. 2. 3″. 3. 2″. 4. 3″. 5. $1\frac{1}{2}$″. 6. 4″. 7. $1\frac{1}{4}$″. 8. 15; 15 ft. 9. 16′. 10. 24′. 11. 24′. 12. $17\frac{1}{2}$′. 13. 39′. 14. 16′.

Page 321. 1. 32 ft. 2. 24′. 3. 32′. 4. 25′. 5. 15′. 6. $14\frac{2}{5}$′. 7. 80′. 8. $37\frac{1}{2}$′. 9. $30\frac{3}{4}$′. 10. 6 in. 11. 12″. 12. $12\frac{1}{2}$″. 13. 14″. 14. 19.5″. 15. 6″. 16. 7″. 17. 8″. 18. 6.3″.

Page 323. 1. 19¢; 31¢; 56¢; \$1.04; \$1.53; \$2.02; \$2.52; \$3.01. 2. 33¢; 81¢; \$3.82. 3. 85¢; \$2.45; \$3.35. 4. \$7.34.

Page 324. 1. 120. 2. 210. 3. 280. 4. 370. 5. 140. 6. 240. 7. 480. 8. 390. 9. 740. 10. 1430. 11. 8100. 12. 12,230. 13. 800. 14. 1300. 15. 2200. 16. 3100. 17. 900. 18. 2900. 19. 950. 20. 3950. 21. 11,800. 22. 17,100. 23. 92,200. 24. 180,300. 25. 300. 26. 600. 27. 900. 28. 800. 29. 1100. 30. 2100. 31. 1400. 32. 1800. 33. 8100. 34. 12,000. 35. 42,100. 36. 44,200. 37. 3000. 38. 7000. 39. 8000. 40. 9000. 41. 2000. 42. 11,000. 43. 12,000. 44. 4000. 45. 21,000. 46. 42,000. 47. 310,000. 48. 433,000. 49. 7000. 50. 9000. 51. 11,000. 52. 14,000. 53. 17,000. 54. 23,000. 55. 26,000. 56. 37,000. 57. 62,000. 58. 198,000. 59. 1,858,000. 60. 2,986,000. 61. 1. 62. 3. 63. 16. 64. 14. 65. 7. 66. 9. 67. 18. 68. 19. 69. 24. 70. 46. 71. 223. 72. 468. 73. 5. 74. 13. 75. 25. 76. 30. 77. 7.2. 78. 9.2. 79. 18.6. 80. 33.28. 81. 51. 82. 317.44.

Page 325. 1. 60%. 2. 68.6%. 3. 43.4%. 4. \$1.23. 5. \$7. 6. 26.1%. 7. 76%. 8. \$105.

Page 326. 1. \$10. 2. \$12. 3. \$12. 4. 25¢. 5. \$2. 6. 90¢. 7. 50¢. 8. \$1. 9. \$4.50. 10. 8¢. 11. 24¢. 12. 56¢. 13. 72¢. 14. \$3.20. 15. \$4.80. 16. \$8. 17. \$64. 18. \$48. 19. \$160. 20. \$1.51$\frac{1}{2}$. 21. \$1.50$\frac{3}{4}$. 22. \$1.53. 23. \$1.56. 24. \$1.65. 25. \$2.25. 26. \$2. 27. \$2.50. 28. \$3. 29. \$3.75. 30. 50%. 31. 200%. 32. 25%. 33. 50%. 34. 100%. 35. $33\frac{1}{3}$%. 36. 125%. 37. 150. 38. 100. 39. 100. 40. 1200. 41. 128. 42. 180. 43. 30,000. 44. 100. 45. 1200. 46. 48. 47. 400.

Page 327. 1. \$220.32. 27. \$178.56. 28. \$2.78. 29. 865.92 yd. 30. 27,084.8 sq. mi. 31. \$1267.50. 32. \$25.23. 33. \$10.91. 34. \$21,120.

Page 328. 1. 11. 2. 319,899. 3. 2427.8. 4. 12.3%.

Page 330. 2. 5 P.M.; 4 P.M.; 2 P.M.; 3 P.M. 3. 11 P.M.; 10 P.M. 4. 12 noon. 5. 90. 6. Ahead; 1 hr. 7. Slower; 5 hr. 8. 5 A.M.; 10 A.M. 9. 8 P.M.; 2 P.M.; 11 A.M. 10. 2 A.M.; 3 A.M. 11. 1 P.M.

Page 332. 1. 4 min. 8 sec. faster. 2. 12 min. 40 sec. 3. 8 min. 56 sec. 4. 33 min. 8 sec. 5. 41 min. 36 sec. 6. 1 hr. 54 min. 20 sec.

7. 4 hr. 2 min. 40 sec. 8. 4 hr. 52 min. 36 sec. 9. 5 hr. 57 min. 48 sec. 10. 61° 1′. 11. 32° 3′. 12. 65° 8′. 13. 45° 10′. 14. 32° 35′. 15. 82° 36′.

Page 333. 1. 6. 2. 24. 3. $1\frac{1}{2}$. 4. 9. 5. 5280. 6. $\frac{1}{2}$. 7. 8. 8. 160. 9. 2000. 10. 500. 11. 16. 12. 27. 13. 144. 14. 18. 15. 6 sq. ft. 16. 10 sq. ft. 17. 80 sq. in. 18. 3 sq. yd. 19. 3 ft. 20. 87 ft. 21. 12 ft. 22. 15,840 ft. 23. 48 yd. 24. 4 yd. 25. $1\frac{1}{2}$ yd. 26. $15\frac{1}{2}$ yd. 27. 8 lb. 28. 17,000 lb. 29. $10\frac{1}{2}$ lb. 30. 7500 lb. 31. $\frac{1}{2}$ sq. ft. 32. 648 sq. ft. 33. $4\frac{1}{2}$ sq. ft. 34. 459 cu. ft. 35. 68 qt.

Page 334. 1. $529.25. 2. $272.84. 3. $574.33. 4. $320.76. 5. $702.60. 6. $1534.59. 7. $1523.51. 8. $500.83. 9. $7076.16. 10. $687.96. 11. $1425.06. 12. $550.37. 13. $31.45. 14. $30. 15. $150. 16. $16. 17. $53.33. 18. $2.50. 19. 926,279. 20. 28,040.53. 21. 1578.924. 22. 301,090. 23. 187.29. 24. 7052.55. 25. $5\frac{5}{8}$. 26. $2\frac{1}{8}$. 27. $6\frac{25}{32}$. 28. $2\frac{3}{14}$. 29. $6\frac{25}{32}$. 30. $\frac{14}{31}$. 31. 109.22688. 32. 24.768; 24.768.

Page 335. 1. *a*. 2. *d*. 3. *c*. 4. *c*. 5. *a*. 6. *c*. 7. *d*. 8. *b*. 9. *c*.

Page 337. 2. 25¢. 3. $5.22. 4. $158.76. 5. 17; $3.70. 6. $5.35. 7. 0.75%.

Page 338. 1. $542.57. 2. $870.19. 3. 85¢.

Page 339. 1. $307.62. 2. $2880. 3. $338.72.

Page 341. 1. $1\frac{15}{16}$¢ below par; $24.23. 2. $24.30. 3. $24.36. 4. $24.20. 5. $24.26. 6. $24.33. 7. $2331. 8. $0.01\frac{3}{8}$¢ below par; $4.88. 9. $11.72. 10. $10.74. 11. $46.88. 12. $72.27. 13. $26.14. 14. $26.20. 15. $26.18. 16. $26.22. 17. $26.35. 18. $178.69. 19. $71.48. 20. $65.52. 21. $357.38. 22. $857.70. 23. $21.32.

Page 342. 1. 1295. 2. 5768. 3. 606. 4. 300. 5. $18.75. 6. $62.50. 7. $1500. 8. $\frac{3}{4}$%.

Page 343. 1. $\frac{4}{15}$%. 2. $2421.25. 3. $11,959.68. 4. 0.3%. 5. $20.

1. 331,172. 2. 22,351.41. 3. 2192.063. 4. 2721.08. 5. $11\frac{1}{8}$. 6. $12\frac{9}{20}$. 7. $23\frac{1}{24}$. 8. $19\frac{7}{10}$. 9. $4\frac{3}{8}$. 10. 165.

Page 344. 1. $1437.50. 2. $870. 3. $18.70. 4. 6¢. 5. $8\frac{1}{2}$ in. 6. 62.7. 7. 120. 8. $373.75. 9. $1764. 10. Copper, 1014 lb.; tin, 186 lb.

Page 345. 1. $270. 2. $330. 3. $2160. 4. $212.50. 5. $412.50. 6. $550. 7. $720. 8. $687.50. 9. $712.50. 10. $2120. 11. $2362.50.

Page 347. 1. *d*. 2. *b*. 3. *a*. 4. *d*. 5. *c*. 6. *a*. 7. *d*. 8. *b*. 9. *a*. 10. *c*. 11. *a*.

Page 348. 1. 1500. 2. $16,000. 3. $46\frac{2}{3}$%. 4. $50. 5. 4500. 6. $120. 7. $30. 8. $50; $1\frac{1}{4}$%. 9. $137,500. 10. $2\frac{1}{2}$%. 11. $1\frac{3}{4}$%. 12. $2\frac{1}{2}$%; $25. 13. $4\frac{1}{2}$%; $112.50. 14. $12,500; $100. 15. $2\frac{3}{4}$%; 10. 16. $1,000,000; $360. 17. $112,500; 100. 18. $5,000,000; $1400.

Page 352. 1. $21,680. 2. $33,668.75. 3. $353.25. 4. $4091; $240. 5. $5228; $340. 6. $36,040. 7. $26,568.75. 8. $10,626. 9. $68,025. 10. $84,180. 11. $1089.50. 12. $5182. 13. $96,570.

Page 353. 1. $170, profit. 2. $322, loss. 3. $933, loss. 4. $2349, profit. 5. $642, profit. 6. $1777.50, profit. 7. $675, profit. 8. $2595, loss.

Page 354. 1. Preferred, 2500; common, 22,500. 2. $900; $1050. 3. $1715, gain. 4. $264.38, gain. 5. $2812\frac{1}{2}$. 6. $22\frac{3}{8}$. 7. 17,475. 8. $7\frac{7}{8}$. 9. $5312\frac{1}{2}$. 10. $47\frac{1}{4}$. 11. $9618\frac{3}{4}$. 12. $5\frac{1}{2}$. 13. 8505. 14. $57\frac{1}{4}$. 15. $72. 16. $176. 17. $120. 18. $176. 19. $252. 20. $960. 21. $2053.25. 22. $3600. 23. $375. 24. $1575.

Page 355. 1. 250. 2. $7500. 3. $1200. 4. $248.13. 5. $87.50.

Page 357. 1. $4935. 2. $275. 3. $13,948. 4. $8509.50. 6. $7016; $400. 7. $5817; $330. 8. $18,598.50; $1170. 9. $25,706.25; $1750. 10. $74,681.25; $4312.50.

Page 358. 1. $236.25. 2. $720. 3. $9000. 4. $23,750. 5. $80,000. 6. $2000. 7. $16,875,000. 8. $2,500,000. 9. $960,000. 11. $7896; $270. 12. $5772; $390. 13. $15,705; $750. 14. $10,870; $700. 15. $26,237.50; $1375. 16. $4885; $350. 17. $8365.50; $360. 18. $20,765; $1100. 19. $23,750. 20. $1187.50; $21,375. 21. Amounts outstanding: $150,000, $135,000, $120,000, $105,000, $90,000, $75,000, $60,000, $45,000, $30,000, $15,000; interest charges: $7500, $6750, $6000, $5250, $4500, $3750, $3000, $2250, $1500, $750.

Page 360. 1. $1.21. 2. 10%. 3. $\frac{2}{3}$. 4. $2.50. 5. $\frac{3}{8}$. 6. $225. 7. $21,375. 8. 19.7¢. 9. $63.75. 10. 15%.

Page 361. 1. $13,000; $18,000; $94,000. 2. 5th; 9th.

Page 362. 1. Selling expenses; delivery expenses; $88,000, $10,000.

Page 363. 1. 66.5¢; 30.2¢; 3.3¢. 2. Total overhead expense. 4. Teachers' salaries; health. 5. $143,995.20; $25,990.40; $10,060.80; $10,480.

Page 364. 1. 45¢. 2. 70¢. 3. $1.20. 4. $1.20. 5. $1.35. 6. $1.75. 7. 6; 9; 15; 30; 0; 12; 21; 33. 8. 11; 15.4; 22. 9. 6; 9; 15.

Page 366. 1. New York. 2. Idaho, Montana, Wyoming, North Dakota, South Dakota, Nevada, Utah, Arizona, New Mexico, Vermont; Washington, Oregon, Colorado, Nebraska, Kansas, Oklahoma, Texas, Minnesota, Iowa, Arkansas, Louisiana, Indiana, Kentucky, Tennessee, Mississippi, Alabama, Georgia, Florida, West Virginia, Virginia, Maryland, Delaware, North Carolina, South Carolina, Maine, New Hampshire, Connecticut, Rhode Island; California, Missouri, Wisconsin, Michigan, New Jersey; Illinois, Ohio, Pennsylvania, Massachusetts. 3. Illinois, Ohio, Pennsylvania, New York, Massachusetts. 5. 7%. 6. Nevada, New Mexico, North Dakota. 7. Illinois, Ohio, New York, Pennsylvania, Massachusetts.

Page 368. 1. First day, 76°, 84°, 72°; second day, 76°, 91°, 90°; third day, 80°, 94°, 91°; fourth day, 66°, 70°, 64°; fifth day, 63°, 64°, 64°. 2. First day, 29.85 in., 29.90 in., 29.93 in.; second day, 29.95 in., 29.92 in., 29.77 in.; third day, 29.80 in., 29.81 in., 29.78 in.; fourth day, 29.87 in., 29.90 in., 29.85 in.; fifth day, 29.89 in., 29.91 in., 29.92 in. 3. February, April, June, July, August, September; January, March, May, October, November, December.

Page 370. 1. 70°; 70°; 60° to 70°. 2. Colorado, New Mexico, Texas, Oklahoma, Kansas, Nebraska, South Dakota, Minnesota, Iowa, Missouri, Arkansas, Louisiana, Mississippi, Illinois, Wisconsin, Michigan, Indiana, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Florida, Virginia, West Virginia, Ohio, Pennsylvania, Maryland, Delaware, New Jersey, New York, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut. 3. Arizona, New Mexico, Texas, Minnesota, Iowa; Wyoming, Colorado, South Dakota, Nebraska, Maine.

Page 371. 1. 64 by trolley; 112 by bus. 2. $16.50. 3. 38%. 4. 637; 13. 5. $600,000. 6. $7848.75. 7. $11,634.

1. 25.499. 2. 16.78. 3. 2135.6. 4. 3.4486. 5. 7897. 6. 0.3456. 7. 0.003234. 8. 0.86. 9. 0.32. 10. 98,000.

Page 372. 2. $110; $297. 4. 6; 48. 5. $\frac{1}{3}$; $\frac{3}{1}$; $\frac{1}{3}$; $\frac{1}{4}$. 6. 0.05. 7. 12. 9. 3. 10. Per cents. 11. 161.7 lb. 12. $\frac{1}{6}\frac{1}{8}$. 13. $357.50. 14. $582.60.

Page 374. 1. 3,000,000 sq. mi.; 750,000 sq. mi.; 3,750,000 sq. mi. 2. 1,920,000,000. 3. 76,000,000; 93,000,000; 107,000,000; 125,000,000. 4. 12; 15%; 41%. 5. 36. 6. 15.7.

Page 375. 1. $10,000,000. 2. $7000. 3. $1,900,000. 4. $30.36. 5. 5.8.

Page 376. 1. Detroit, $11,000,000; Kansas City, $12,000,000; St. Louis, $14,000,000; Boston, $17,000,000; Philadelphia, $21,000,000; Chicago, $62,000,000; New York, $74,000,000. 2. 19%; 252%. 3. $211,000,000; 30%. 4. 1918, 1919, 1920; $25,600,000,000. 5. 26; 16%. 6. $3,500,000,000; 500%. 7. 347 da.

Page 377. 1. 13%. 2. 28.9%. 3. $22.11. 4. $51,538,000. 5. 2%. 6. 1%. 7. 25%. 8. 29%. 9. 2%. 10. 3%.

Page 378. 1. 11.3%. 2. $85.14. 3. $687,550. 4. $67.41; $17.73, less. 5. 1%. 6. 31%. 7. 2%. 8. 21%. 9. 9%. 10. 9%.

Page 379. 2. 36. 3. $5.45. 4. $15.38. 6. 8.

Page 381. 1. $90,530.92. 2. $406,908.60. 3. $1,129,542.40. 4. $57,579.50. 5. $16,350.68. 6. $773,890.75. 7. $37,675.45. 8. $10,685.72. 9. $277,886.05. 10. $715,774. 11. $39,511,250. 12. $745,032.60. 13. 0.08. 14. $62.13. 15. $12.56. 16. $2025. 17. $5782.50. 18. $37,510. 19. $109,550. 20. $2,095,000. 21. $36,300. 22. $40,062.50 23. $550,000. 24. $3,926,700. 25. $102,508,000.

Page 382. 1. 120. 2. 15%. 3. 19,643 sq. mi. 4. 3.4. 5. 12. 6. $10. 7. 2¼. 8. 11,700. 9. 14.4 T. 10. 30%.

Page 383. 1. 26.2%. 2. 9.2%. 3. 197.7%; 82.4%. 4. 1.4%.

Page 384. 1. Ad valorem. 2. Specific. 4. $45. 5. $647.50; $1101.80; $3073. 6. $52; $113.75; $374.40. 7. $927. 8. $144. 9. $1200. 10. $10,175. 11. $8800. 12. $806.40. 13. $20,000. 14. $11,700. 15. $258. 16. $360. 17. $90. 18. $1097.50.

Page 387. 1. $2800; $42; $31.50. 2. $2300; $25.87. 3. $60; $98.40; $158.40; $118.80. 4. 1.1%. 5. $57.71. 7. $785.75; $11.79; $2.95; $8.84. 8. $1990.40; $29.86; $7.47; $22.39. 9. $1980.36; $29.71; $7.43; $22.28. 10. $3286.72; $49.30; $12.33; $36.97.

Page 388. 1. $1793. 2. $190.40. 3. $51.42; $38.56. 4. $8.61. 5. $322.38. 6. $577.80. 7. $33. 8. $1248. 9. $2285. 10. $2550. 11. $6348.50. 12. $8426. 13. $16,177.38. 14. $57.89. 15. $110.92. 16. $293.81. 17. $192.84. 18. $1455. 19. $4085.50. 20. $10,112.10. 21. $13,624.56.

Page 390. 1. $19.80. 2. 7.5 mills. 3. 6.25 mills. 4. 8.5 mills. 5. 11.9 mills. 6. 24.5 mills. 7. $18.50. 8. $21.60. 9. $28.20. 10. $26.50.

Page 391. 1. $218.24. 2. $170.04. 3. $106.68. 4. $306.25. 5. $162.44. 6. $717.50. 7. $367.92. 8. $516.88. 9. $1438.20. 10. $3100. 11. $22.60.

Page 392. 1. $8000; $164.80. 2. $9150; $193.98. 3. $14,500; $391.50. 4. $11,150; $206.28. 5. $18,100; $465.17. 6. $13,250; $351.13. 7. $20,500; $352.60. 8. $29,600; $538.72. 9. $12,050; $298.84. 10. $38,300; $1194.96. 11. $60,500; $1482.25. 12. $82,150; $2349.49. 13. $63,400; $2244.36. 14. $74,950; $2128.58.

Page 394. 1. 8. 2. 40; 4 less. 3. 7; yes. 4. 6,430,000; yes. 5. 3797; no. 6. Mr. A; 13,448; no. 7. Mr. C; 40,131; yes. 8. Mr. B; 6772; no. 9. Mr. D; 11,332; yes. 10. Mr. B; 33,042; no.

Page 395. 1. $2940. 2. $42.60. 3. 0.4%. 4. $276.71. 5. 64,919; no. 6. $7357.50. 7. $139.31. 8. 15,689. 9. 29,945. 10. $792. 11. $1830. 12. $6510. 13. $54.79. 14. $86.93. 15. $442.27. 16. $385.70. 17. $5686.05.

Page 396. 1. $20.25. 2. $6.30. 3. 7 hr. 4. 448 bu. 5. $18. 6. $8.25. 7. $20.40. 8. 437 yd. 9. $1134. 10. 92.2 ft.

Page 397. 1. 24,250,000. 2. 74.8%. 3. 7,552,000. 4. $99.43. 5. $82.47; $16.96 less. 6. 133,333.

Page 398. 1. 170,000, 140,000, 220,000, 270,000, 420,000, 520,000; 90,000, 110,000, 130,000, 170,000, 240,000, 320,000. 2. 206%; 256%. 3. 434. 4. $32,760. 5. 30.4%. 6. 15%.

Page 399. 1. Chicago, 3.8; New York, 3.3. 2. 60%. 3. 1.77¢. 4. 40.5%. 5. 2.5. 6. 90¢. 7. 18.6%. 8. 3.

Page 400. 1. 2,142,720. 2. 45.8%. 3. 20. 4. 2.70 mi.

Page 401. 1. Western. 2. 216,250. 3. 3.1%. 4. 21.8%. 5. $1.89.

Page 402. 1. $257.06. 2. $27.07. 3. 16 ft. 3 in. 4. $26.64. 5. $226.36. 6. 3.546. 7. 0.3502. 8. 678.24. 9. 37 ft. 4 in. 10. 0.17514. 11. 26.25. 12. 2.454. 13. 4.14. 14. 0.0504. 15. $10\frac{1}{16}$. 16. 4. 17. $7\frac{5}{8}$. 18. $2\frac{11}{12}$. 19. 18 ft. 9 in. 20. 9 in. 21. 12.4. 22. 660. 23. 25%. 24. 28.9. 25. 0.05. 26. 600%. 27. $468. 28. 1. 29. 25. 30. $11\frac{1}{9}$%. 31. $33\frac{1}{3}$%. 32. 20.

Page 403. 1. 6.7. 2. 20.1. 3. 5460; 2500; 45.8%. 4. 1.5%; 17.0%. 5. 256,135. 6. 6.9. 7. Football field; 400 sq. yd.

Page 404. 1. 650 ft.; 32,500 ft. 2. 23.3 ft. per second. 3. 29.8 ft. per second. 4. 19.4%.

Page 405. 1. 9.0%. 2. 21; 8. 3. 38.1%. 4. Fourteenth. 6. 4.5%.

Page 406. 1. 3400. 2. 88.2%. 3. Proteins, 553; carbohydrates, 2425.5; fats, 521.5. 4. 67.2%. 5. 69.7%. 6. 3 oz. 7. Proteins, 20.0%; carbohydrates, 28.2%; fats, 51.8%. 8. 32.5%. 9. 3515; 46.5%. 10. $18\frac{1}{3}$¢. 11. 14.4¢.

Page 408. 1. 31.5%. 2. United States, $696; Canada, $477.78. 3. Sailing vessels, 328 T.; steam vessels, 785 T. 4. 38.9%. 5. 63. 6. 5131. 7. 2488. 8. 142.715. 9. 426,856. 10. 769. 11. $5\frac{3}{4}$¢. 12. 9569. 13. 159,244. 14. 91.8. 15. $16\frac{1}{2}$¢. 16. $2591\frac{1}{64}$. 17. 85,775.

Page 409. 1. 89. 2. 25. 3. 91. 4. 205. 5. 128. 6. 12. 7. 24. 8. 19. 9. 12. 10. 12. 11. 30. 12. 52. 13. 40. 14. 40. 15. 6. 16. 15. 17. $1\frac{1}{4}$. 18. $\frac{1}{4}$. 20. $\frac{3}{16}$. 22. $\frac{1}{2}$. 23. 1. 25. $\frac{2}{5}$. 26. 24. 27. $\frac{1}{5}$. 28. $\frac{1}{4}$. 29. 18. 30. 3. 31. 2. 32. 0.5. 33. 25%. 34. 50%. 35. 60. 36. 36. 37. $\frac{1}{2}$. 38. 50%. 39. $33\frac{1}{3}$%. 40. 25%. 41. 20%.

Page 410. 1. 14,936. 2. 24,866. 3. $161.48. 4. 884.9. 5. 24.049. 6. 3877. 7. 2276. 8. $6.05. 9. 0.889. 10. 188.9. 11. 14,208. 12. 9610. 13. 75.5. 14. 46.5. 15. $522\frac{1}{32}$. 16. 129.6. 17. 210. 18. 139.15. 19. 17. 20. $6\frac{3}{4}$. 21. 482. 22. 3.2. 23. 57,348. 24. 198. 25. $750. 26. 0.8. 27. $33\frac{1}{3}$%. 28. 39.2. 29. $166\frac{2}{3}$%. 30. 0.075. 31. $49\frac{3}{8}$. 32. $5\frac{1}{4}$. 33. $16.61. 34. $50,000. 35. $1457\frac{3}{4}$. 36. 30%.

Page 412. 1. 10.2 lb. 2. 24 in. 3. $142.50. 4. $320. 5. 1.25 lb. 6. $4500. 7. $19\frac{7}{8}$. 8. $8.44. 9. 32.8 mi. 10. Texas, 0.06; Illinois, 0.21.

Page 414. 1. $6\frac{1}{4}$%. 2. 25%. 3. 30¢. 4. $40. 5. 100%. 6. 1¢. 7. 60¢. 8. 45¢. 9. 7.2¢. 10. Coal; 9¢. 11. 27¢ less. 12. Electric; 25¢. 13. 48. 14. 7.2¢. 15. $6\frac{2}{3}$ T.; $18.67. 16. Lose, $9.83; gain, $8.84.

Page 416. 1. 8.9%. 2. $32.50. 3. $4485. 4. $81,818.18. 5. $600; $82.01. 6. $55.17. 7. $948.48; $51.52. 8. 29.8%.

...7. 1. √. 2. 0. 3. 0. 4. √. 5. 0. 6. 0. 7. √. 8. √. 9. √. 10. 11. √. 12. 0. 13. √. 14. √. 15. 0. 16. √. 17. 0. 18. 0. 19. 0. 20. 0. 21. 22. 22. 11. 23. 133. 24. 10. 25. 42. 26. 703. 27. $\frac{1}{8}$. 28. 225. 29. 9. 30. $4\frac{1}{4}$. 31. $14\frac{3}{4}$. 32. $20\frac{7}{8}$. 33. 35. 34. $312\frac{1}{2}$. 35. 20. 36. 21.7. 37. 0.1. 38. 43.2. 39. 39. 40. 510. 41. 126. 42. 533. 43. 32. 44. $6\frac{3}{8}$. 45. 2.7. 46. 20.66. 47. $42\frac{1}{4}$. 48. 19. 49. $9\frac{5}{8}$. 50. 2.479.

Page 418. 1. $\frac{1}{2}$; $\frac{1}{3}$. 2. Cement, 2170 bbl.; sand, 620 cu. yd.; crushed rock, 930 cu. yd. 3. 0.51 cu. yd. 4. 20 cu. yd.; sand, 10 cu. yd.; crushed rock, 15 cu. yd. 5. $13\frac{1}{3}$; cement, $23\frac{1}{3}$ bbl.; sand, $6\frac{2}{3}$ cu. yd.; crushed rock, 10 cu. yd. 6. Cement, 2500 bbl.; sand, 1000 cu. yd.; crushed rock, 1750 cu. yd. 7. 36. 8. 63%; 52%; 35%; 23%. 9. $\frac{23}{63}$; $\frac{23}{52}$. 10. Cement, 7040 bbl.; sand, 1936 cu. yd.; crushed rock, 3872 cu. yd. 11. 240. 12. Sand, 120 cu. yd.; cement, 300 bbl.; crushed rock, 210 cu. yd.

Page 420. 1. 2,250,000. 2. 51.7. 3. $168,165. 4. 1600. 5. 10,500. 6. 123.5%.

Page 421. 1. $2. 2. 10%. 3. $56; $38; $6. 4. 56%. 5. $100. 6. $375. 7. Lost; 60¢; $13\frac{1}{3}$%. 8. $8\frac{1}{2}$%.

Page 422. 1. $1237.50. 2. $7.67. 3. $754.11. 4. $2265.50. 5. 28%. 6. $4.90. 7. $6187.50. 8. $2.50. 9. 10%; $16\frac{2}{3}$%. 10. $25.

Page 423. 1. $20,440.80. 2. $32. 3. 40%; 45%; 15%. 4. Materials, $11.27; labor, $9.31; overhead, $3.92. 5. 60¢. 6. 10%; $13\frac{1}{3}$%. 7. $3.99. 8. $16.80. 9. $28.

Page 424. 1. 175; 70; 7. 2. 52.6%. 3. 1,470,588,235 ft. 4. 5.0%. 5. $9089.60.

Page 425. 1. 16,320. 2. 237.5. 3. 24 lb. 4. $24.19. 5. 25.9%. 6. 64.8. 7. $175.50. 8. 3.5¢. 9. 29.9%. 10. $14.90.

Page 426. 1. 300. 2. $25. 3. 12%. 4. 80.4. 5. $131.25. 6. $5.32. 7. 8%. 8. $840. 9. 5%. 10. $6.30.

Page 430. 1. 21 sq. in. 2. 8.8 sq. ft. 3. 12.8 sq. yd. 4. 3.0 sq. mi. 5. 62.44 sq. ft. 6. 37.27 sq. in. 7. $21\frac{1}{8}$ sq. rd. 8. 35.3 sq. rd. 9. $9\frac{5}{8}$ sq. yd. 10. 780 sq. ft. 11. $224. 12. 2000 sq. ft.; 5 lb. 13. 10.1 qt. 14. 60-inch. 15. $360. 16. $5866\frac{2}{3}$. 17. $6. 18. $10\frac{1}{2}$ in. by $7\frac{7}{8}$ in.; $82\frac{11}{16}$ sq. in.

Page 432. 1. $\frac{1}{8}$. 2. 2; 4. 3. 4. 4. 10″; 20″. 5. 9. 6. Third; first. 7. 3; 9. 8. 3; 9. 9. 6.

Page 433. 1. $720. 2. Same; 256 sq. in. 3. 116 sq. in. 4. 78 sq. ft. 5. $76\frac{1}{8}$ sq. in. 6. 21 sq. yd. 7. 20 sq. rd. 8. 1750 sq. ft. 9. $6\frac{3}{4}$ sq. ft. 10. 8.8 sq. mi. 11. 5400 sq. ft. 12. $36\frac{1}{16}$ sq. in. 13. 4.3 sq. yd. 14. $44\frac{5}{8}$ sq. rd. 15. 28.69 sq. in.

Page 434. 1. 36 sq. in.; no. 3. 21 sq. in.; 24 sq. in.; $19\frac{1}{2}$ sq. in.; $16\frac{1}{2}$ sq. in. 4. $\frac{5}{16}$. 5. Same; $26\frac{8}{9}$ sq. ft. 6. Third; 81 sq. in.; $82\frac{1}{8}$ sq. in.; $83\frac{1}{4}$ sq. in. 7. $17\frac{1}{2}$ sq. in. 8. $25\frac{1}{2}$ sq. ft. 9. $4\frac{1}{8}$ sq. ft. 10. $3\frac{15}{16}$ sq. yd. 11. $12\frac{3}{8}$ sq. rd. 12. $7\frac{3}{16}$ sq. rd. 13. 918 sq. rd. 14. $30\frac{5}{8}$ sq. in. 15. 3 sq. in.; 6 sq. in.; 6 sq. in.; 12 sq. in.; 27 sq. in. 16. 2; 4.

Page 436. 1. $2\frac{1}{2}$ sq. in. 2. $7\frac{3}{4}$ sq. in. 3. $10\frac{1}{8}$ sq. ft. 4. 23 sq. in. 5. $25\frac{3}{8}$ sq. ft. 6. $68\frac{3}{4}$ sq. ft. 7. 52 sq. ft. 8. $58\frac{1}{2}$ sq. ft. 9. 15 sq. in. 10. $11\frac{1}{4}$ sq. in. 11. $8\frac{1}{8}$ sq. in. 12. Two. 13. 7500 sq. ft. 14. 13,400 sq. ft.; 11,000 sq. ft. 15. 100 ft.; 12,250 sq. ft. 16. 13,000 sq. ft. 17. 7500 sq. ft. 18. 4 sq. in. 19. $35\frac{3}{4}$ sq. ft. 20. 60 sq. ft.; 240 sq. ft.

Page 438. 1. 100 ft.; 20 ft. 2. 864. 3. 18 ft.; 144. 4. 20 ft.; 12 ft.; 10 ft.; 160. 5. $5\frac{3}{4}$. 6. 4752 ft. 7. 250. 8. 43 ft. 9. 28 sq. ft. 10. 36 sq. ft.; 20 sq. ft.; 32 sq. ft.; 47 sq. ft.; 163 sq. ft. 12. 171. 13. 7.5.

Page 441. 1. 11 ft.; 11 ft. 2. 30. 3. 7 ft. 4 in.; 36,666 ft. 8 in. 4. 98.56 ft.; 98.52 ft. 5. $\frac{7}{22}$; $\frac{7}{22}$ C. 6. 35 in. 7. 28 ft.; 14 ft. 8. 11 in.

Page 443. 2. 154. 3. 124.7 sq. in.; 124.7 sq. in. 4. $\frac{1}{4}$. 5. 77,000 sq. ft. 6. 2; 4. 7. $5\frac{1}{4}$ ft.; 33 ft.; $86\frac{5}{8}$ sq. ft. 8. 2.1 in.; 13.2 in.; 13.9 sq. in. 9. 7 in.; 22 in.; $38\frac{1}{2}$ sq. in. 10. 1.4 yd.; 0.7 yd.; 1.5 sq. yd. 11. 8.4 in.; 26.4 in.; 55.4 sq. in. 12. 8.4 ft.; 4.2 ft.; 55.4 sq. ft.

Page 444. 1. 768. 2. 876. 3. 672. 4. Second; third; 204 sq. ft. 5. 8. 6. 3000 sq. ft. 7. 70 ft.; 3850 sq. ft. 8. 90 sq. in. 9. 576 sq. in. 10. 10 sq. ft. 11. 15 in.; $13\frac{1}{2}$ sq. in. 12. 10 ft.; $6\frac{1}{4}$ sq. ft. 13. 110 in.; $962\frac{1}{2}$ sq. in.

Page 445. 1. 210 sq. in. 2. 144. 3. 25 sq. in. 4. 1080. 5. 240.

Page 446. 2. $42\frac{7}{8}$ cu. in. 3. 20,000. 4. $183\frac{3}{4}$ lb. 5. 16. 6. 12. 7. 10. 8. $833\frac{1}{3}$. 9. 60 cu. ft.; 120 cu. ft.; 240 cu. ft.; 480 cu. ft. 10. 2; 4; 8. 11. 147 cu. ft. 12. $37\frac{1}{2}\frac{1}{2}$ cu. in. 13. 3 ft. 14. 5 in. 15. 0.8 ft.

Page 449. 1. 1408 sq. ft. 2. 6 ft.; 3168 cu. ft. 3. $1299\frac{3}{8}$; $9745\frac{5}{16}$. 4. Yes. 5. 2. 6. 22 in.; 220 sq. in.; 385 cu. in. 7. $25\frac{1}{7}$ ft.; 352 sq. ft.; 704 cu. ft. 8. $3\frac{1}{2}$ in.; 264 sq. in.; 462 cu. in. 9. 7 in.; 44 in.; 1232 cu. in. 10. 96.8 ft.; 4356 sq. ft.; 33,541.2 cu. ft.

Page 450. 1. 3520. 2. 19,800. 3. 450 sq. ft.; 5 ft.; $83\frac{1}{3}$.

Page 451. 1. 3; can, $57\frac{3}{4}$ cu. in.; cone, $19\frac{1}{4}$ cu. in. 2. 3456. 3. 16 cu. in. 4. $37\frac{1}{2}$ cu. ft. 5. 19,200 cu. ft. 6. 108 cu. in. 7. $171\frac{1}{4}$ cu. ft. 8. $2887\frac{1}{2}$ cu. ft.

Page 452. 1. 36. 2. 54. 3. 72. 4. 33. 5. 30. 6. 27.

Page 453. 1. 192. 2. 31.8 cu. in.; 40.3 cu. in.; 67.4 cu. in. 3. 26.7%; 40.2%. 5. $19\frac{1}{2}$. 6. 3. 7. 277,200; $332.64. 8. 13.33. 9. 12.96; less; 0.37 T.

Page 454. 1. 7.5%. 2. 60. 3. $46. 4. $26; $6448. 5. 3; 200%. 6. $11.88. 7. $44,000. 8. $20,741. 9. National, $60,825.60; state, $91,238.40; city, $76,032. 10. $7.18. 11. $11.99; $4.81 more.

Page 456. 1. 2678. 2. $237.48. 3. 1362.7. 4. $80\frac{7}{8}$. 5. 20 ft. 6. 174. 7. $20.77. 8. 1.087. 9. $8\frac{5}{8}$. 10. 63 ft. 11. 84,150. 12. 540,100. 13. $52.03. 14. 87.92 ft. 15. 132 in. 16. 126 ft. 17. 322. 18. 7.6. 19. $752. 20. 320 ft. 21. $38\frac{1}{2}$ in. 22. 24 yd. 23. 756. 24. $400. 25. 22. 26. 7. 27. 25%. 28. 24. 29. 10. 30. 8. 31. 7. 32. 10.

Page 457. 1. 16. 2. 25. 3. 64. 4. 81. 5. 100. 6. 144. 7. $\frac{1}{9}$. 8. $\frac{1}{16}$. 9. $\frac{4}{9}$. 10. $\frac{49}{64}$. 11. 0.04. 12. 0.0036. 13. 2. 14. 4. 15. 5. 16. 6. 17. 9. 18. 8. 19. 10. 20. 12. 21. 11. 22. $\frac{1}{3}$. 23. $\frac{1}{4}$. 24. $\frac{1}{7}$. 25. $\frac{2}{3}$. 26. $\frac{3}{5}$. 27. $\frac{4}{9}$. 28. 0.6. 29. 1.2. 30. 0.05.

Page 458. 1. 15. 2. 20. 3. 21. 4. 18. 5. 24. 6. 36. 7. 25. 8. 30. 9. 4.5. 10. 3.3. 11. 250 ft. 12. 45 ft. 13. 640 ft.

Page 461. 1. 40. 2. 50. 3. 31. 4. 45. 5. 5.2. 6. 6.5. 7. 23.6. 8. 12.6. 9. $\frac{23}{25}$. 10. $\frac{34}{35}$. 11. 2.6. 12. 4.2. 13. 5.9. 14. 6.8. 15. 12.0. 16. 23.8. 17. 29.7. 19. 106.5; 300.7. 20. 8.06. 21. 8.49. 22. 6.40. 23. 11.09. 24. 27.09. 25. 31.24. 26. 35.27. 27. 36.82. 28. 51.77. 29. 61.44. 30. 12.6 rd. 31. 67.1 ft.

Page 462. 1. 25.0 in. 2. 35.0 in. 3. 40.0 in. 4. 76.6 ft. 5. 85.0 ft. 6. 105.0 rd. 7. 12.5″. 8. 163.5′. 9. 260.5′. 10. 30 ft. 11. 6.8 in. 12. 160 ft. 13. 183.6 ft. 14. 20 ft.; 21.9 ft. 15. 49; 7; 7 in.; 7 ft. 16. 14 in. 17. 2.6 in.; 5.6 ft. 18. 3.7 in. 19. 1.9 in. 20. 6.2 ft. 21. 1.7 in. 22. 2.9 ft. 23. 2.4 yd.

Page 464. 1. 123.5 rd.; 494 rd. 2. 988 rd. 3. 7 in. 4. 176 ft. 5. 10.4 in. 6. 64. 7. 1.21. 8. 0.81. 9. $\frac{1}{16}$. 10. $\frac{4}{9}$. 11. $\frac{9}{16}$. 12. 4. 13. 5. 14. 1.1. 15. 0.7. 16. 60. 17. 90. 18. $\frac{1}{4}$. 19. $\frac{3}{4}$. 20. $\frac{4}{5}$. 21. $\frac{7}{9}$. 22. 6.2. 23. 8.7. 24. 11.8. 25. 40.6. 26. 91.0. 27. 6.0 in. 28. 58.3 ft. 29. 13.5 in. 30. 22.2 ft. 31. 87.3 ft. 32. 2241.0 ft.

Page 465. 1. 4. 2. 6. 3. 8. 4. 9. 5. 0.5. 6. 12. 7. 1.5. 8. 40. 9. $\frac{1}{4}$. 10. $\frac{2}{5}$. 11. 7 in. 12. 10 in. 13. 15 ft. 14. 1.4 ft. 15. 1.2 in. 16. 30 ft. 17. $\frac{1}{3}$ yd. 18. $\frac{3}{4}$ in. 19. $\frac{4}{5}$ ft.

Page 468. 1. 324. 2. 961. 3. 74,088. 4. 474,552. 5. 11.56. 6. 19.683. 7. 4.243. 8. 8.832. 9. 3.826. 10. 8.124. 11. 2.924. 12. 9.434. 13. 9. 14. 39. 15. 25. 16. 87.18. 17. 12.6. 18. 0.4899. 19. 1.9. 20. 0.208. 21. 5.7. 22. 110. 23. 2.2. 24. 19.9. 25. 5.848. 26. 12.648. 27. 14.56. 28. 7.368. 29. 6.348. 30. 1.811. 31. 1.7436. 32. 0.4761. 33. 0.482. 34. 1.7 in.; 4.1 in.; 2.6 in. 35. 8.0 in.; 5.5 in.; 8.5 in. 36. 30 ft. 37. 2.8 in.; 7.7 ft.

Page 469. 1. 1.005 lb. 2. 0.578 oz. 3. 849.021 lb.; 7.861 oz.

Page 470. 1. 180°; 100°. 2. 1.8°. 4. 68°; 100.4°; 158°. 5. 219°. 6. 56° F.; 150° F.

Page 471. 1. 0.242 oz. 2. 3.0%. 3. 35.428 lb. 4. 37.301 lb. 6. 487.5 lb. 7. 46,103.9 T. 8. 199.1 lb. 9. 17,568 lb.(8.8 T.).

Page 472. 1. 1350 ft. 2. 91.8%. 3. Fresh water; 1377 ft. 4. 9%. 5. 95,040,000 lb.

Page 473. 1. 1100 ft. per second; 1114 ft. per second; 1130 ft. per second. 2. 4360 ft. per second; 4432 ft. per second; 4504 ft. per second. 3. 14.9. 4. 2.7.

Page 474. 1. $8\frac{1}{3}$. 2. 0.13 sec. 3. 4.0 hr. 4. 669,600,000 mi.; 16,070,400,000 mi.; 5,865,696,000,000 mi. 5. 258,090,624,000,000 mi. 6. 2.5 mi.

Page 475. 1. 21.3. 2. 42.4. 3. 67.0 mi. per hour. 4. 120. 5. 32.4 mi. per hour. 6. 15.8 hr. 7. 46.9. 8. 1840.9. 9. 130 hr.

Page 476. 1. 8. 2. $4\frac{1}{2}$. 3. 6. 4. $6\frac{1}{4}$.

Page 477. 1. 90 lb. 2. 60 lb. 3. 80 lb.; 160 lb. 4. 480 lb.

Page 478. 1. 62.7. 2. 9.8. 3. 6.7%. 4. 1.34.

Page 479. 1. $\frac{3}{4}$ in. 2. 214. 3. 6.048 lb. 4. 14.0. 5. 71°. 6. Mercury, 220,492,800 mi.; Venus, 408,240,000 mi. 7. 110 ft. per second. 8. 4.4. 9. 10,964 ft. 10. 1.7 mi. 11. 24.4°. 12. 36.3° F.; 29.2° F. 13. 1,145,894 lb. 14. 22.785 lb. per square inch.

Page 481. 1. 7600; 760,000. 2. 8250; 8.25; 1.5. 3. 0.001; 2200; 5600; 100,000.

Page 482. 1. 0.1. 2. 1000. 3. 0.001. 4. 10. 5. 100. 6. 1000. 7. 2. 8. 4.4. 9. 1.2. 10. 2.6. 11. 5.5. 12. 24. 13. 6. 14. 36.5. 15. 30 mi. per hour. 16. 5100 mi. 17. 60 km. per hour; 36 mi. per hour. 18. 0.034 cm. 19. 2.8 in. 20. 0.001. 21. 1000. 22. 10 cm. 23. 0.001 cu. m. 24. 1,000,000. 25. 1000 kg. 26. 2200 lb.; 35.9. 27. 71.2 kg.; 164.6 lb.

Page 484. 1. $1633\frac{1}{3}$ km. 2. 1.9 yd. per second. 3. 4 ft. 10 in.; 93.5 lb. 4. 2.88. 5. 2.82. 6. 864 l. 7. 260.4 gal. 8. 165. 9. 495. 10. 227.3. 11. 75.8. 12. 5. 13. 18. 14. 2.5. 15. 4.4. 16. 0.45. 17. 0.23. 18. 220. 19. 45.5. 20. 2200. 21. 909.1.

Page 485. 1. $365.56. 2. $414.32. 3. $359.83. 4. $357.47. 5. $30.37. 6. $35.59. 7. $17.46. 8. $4.80. 9. 309,876. 10. 98,760. 11. 47,609. 12. 143,611. 13. 16,298,720. 14. 25,237,568. 15. 300,614,930. 16. 2,047,922. 17. 44,025,660. 18. 240,309,280. 19. 75,248,957. 20. 36,543,336. 21. 224,504,196. 22. 320,570,670. 23. 146,859,135. 24. 477,254,400. 25. 5108. 26. 6672. 27. 7006. 28. 10,770. 29. 8578. 30. 4000. 31. 45.36. 32. 5610.32. 33. 9007.9.

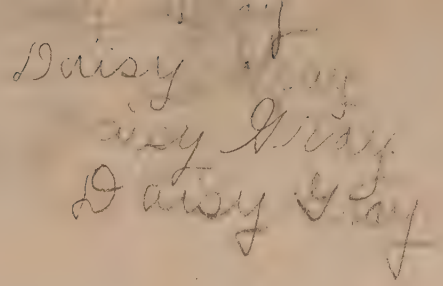
Page 486. 1. $1\frac{1}{2}$. 2. $1\frac{5}{8}$. 3. $\frac{1}{4}$. 4. $\frac{5}{16}$. 5. $\frac{3}{16}$. 6. $1\frac{1}{4}$. 7. $\frac{2}{7}$. 8. 2. 9. $1\frac{3}{8}$. 10. $6\frac{3}{8}$. 11. $4\frac{5}{16}$. 12. $1\frac{5}{8}$. 13. 4. 14. $4\frac{1}{8}$. 15. 6. 16. $22\frac{11}{32}$. 17. 10.21. 18. 3.64. 19. 3121.44. 20. 56.088. 21. 248.5472. 22. 67.7718. 23. 0.38276. 24. 7760.4415. 25. 88. 26. 7.908. 27. 8.02. 28. 8.75. 29. $182.10. 30. $107.10. 31. $294.70. 32. $480.15. 33. $1382.15. 34. $593.53. 35. $8750. 36. $3061.53. 37. 210. 38. 63. 39. $115\frac{1}{2}$. 40. 58. 41. 67. 42. 62. 43. $50.70. 44. $328. 45. 25%. 46. $17,480. 47. 8%. 48. $0.50.

Page 487. 1. $228\frac{1}{8}$. 2. $16\frac{2}{3}$%; $14\frac{2}{7}$%. 3. $192.50. 4. $59.05. 5. $8\frac{1}{2}$. 6. Fat, 46.2%; water, 46.2%; lye, 7.7%. 7. 15%. 8. 2.0 in. 9. $1.60. 10. $4800. 11. $62.50.

Page 488. 2. $92.50; $370. 4. 1%. 5. Numerator; denominator. 16. Rise; fall. 17. 4.955.

Daisy Gray
Daisy Gray

Daisy Gray
Daisy Gray
Daisy Gray



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Daisy Gray

Grade 7

Daisy Gray

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Daisy Gray

INDIANA RETAIL PRICE
55 CENTS